

#### F.4.1.1.6 Water Resources

The use of RBOF and the L-Reactor disassembly basin for the interim storage of foreign research reactor spent nuclear fuel would not change the current levels of water usage at these facilities. Nor would it change thermal discharges from cooling water or the quantity or quality of radioactive and nonradioactive wastewater effluents.

Viable accidents during this interim storage period could be a release of pool water onto the ground surface or a breach of the liner of the wet storage basins in which the spent nuclear fuel would be stored. These type of accidents have been analyzed for both the RBOF and the L-Reactor disassembly basin in the safety analysis documentation (Dupont, 1983a and 1983b; WSRC, 1995b and 1995c) and the Programmatic SNF&INEL Final EIS (DOE, 1995g). As discussed in the Programmatic SNF&INEL Final EIS, radionuclides in the released water would enter the water table aquifer but would not reach any surface-water or any drinking water aquifer on or off the Savannah River Site. Basin water contains no toxic or hazardous chemicals, therefore, accidental releases from the basins would have minimal impacts on surface- and groundwater resources.

#### F.4.1.2 New Facilities (Phase 2)

Analysis options 1B and 1C involve the use of new facilities for the storage of foreign research reactor spent nuclear fuel at the Savannah River Site. The environmental impacts analyzed relate to the construction and operation of these new facilities. The impacts include: land use; socioeconomic; cultural resources; aesthetic and scenic resources; geology; air and water quality; ecology; noise; traffic and transportation; occupational and public health and safety; materials, utilities and energy; and waste management.

##### F.4.1.2.1 Dry Storage

Analysis option 1B is associated with the construction and operation of new dry storage facilities. The dry storage option encompasses both the dry vault design and the dry cask design as described in Section 2.6.5 of this EIS and earlier in this appendix. None of the environmental impact parameters discriminate between the two designs. For the purpose of this analysis, the impacts from the larger dry vault design are presented.

##### F.4.1.2.1.1 Land Use

A new dry storage facility would be located in one of two 60-plus ha (150-plus acres) undeveloped areas near the H- and P-areas, respectively. Predominant land use at both areas is managed timber land. Construction activities, including laydown areas, would disturb 3.7 ha (9 acres) of land. This represents about 6 percent of the available space at either area. A new dry storage facility would occupy 5,000 m<sup>2</sup> (54,000 ft<sup>2</sup>) of land and would move 11,000 m<sup>3</sup> (14,400 yd<sup>3</sup>) of soil. Neither construction nor operation of a new dry storage facility at either area would significantly impact land use patterns on the Savannah River Site.

##### F.4.1.2.1.2 Socioeconomics

As discussed in Section F.3.1.1 the total capital cost of a new dry storage facility is estimated to be \$370 million. Construction activities are projected to take 4 years. Assuming that the capital cost is

evenly distributed over this 4-year period, the annual expenditures would be about \$92.5 million. This represents about 7.7 percent of the estimated FY 1995 total expenditures for the Savannah River Site. The relative socioeconomic impact from annual construction expenditures on the region of influence would be small but positive. The annual operations costs from a new dry storage facility are estimated to be \$15.6 million for receipt and handling and \$.6 million for storage. These costs represent about 1.3 percent and 0.05 percent of FY 1995 total expenditures for the Savannah River Site. The relative socioeconomic impact from annual operation expenditures on the region of influence would be small.

Direct employment associated with construction of new dry storage facility is estimated to be 190 persons. The relative socioeconomic impact from construction employment on the region of influence would be small. In addition, when compared to the projected FY 1995 work force at the Savannah River Site of approximately 20,000 persons, the relative socioeconomic impact of this temporary increase in construction employment would be insignificant. Direct employment associated with receipt and storage operations is estimated to be 30 persons. Upon completion of these activities, direct employment is expected to decrease to eight persons. The relative socioeconomic impact of this increase in operations employment would be insignificant to both the region of influence and the Savannah River Site.

#### **F.4.1.2.1.3 Cultural Resources**

There are no known cultural or historic resources located within the two proposed construction locations for a new dry storage facility. Both locations are within an area of low archaeological site density. Activities within this zone would have a low probability of encountering archaeological sites and virtually no chance of impacting large sites with more than three prehistoric components. Neither location has been specifically surveyed for archaeological resources, but this would occur prior to initiation of any construction-related activities.

Three Native American groups have expressed concerns relating to the possible existence on the Savannah River Site of several plant species traditionally used in Tribal ceremonies. These plant species are known to occur on the Savannah River Site, typically in wet, sandy areas such as evergreen shrub bogs and savannas. However, these plants are not likely to be found in the two proposed construction locations because of a lack of suitable habitat.

#### **F.4.1.2.1.4 Aesthetics and Scenic Resources**

Construction and operation of a new dry storage facility would not adversely impact aesthetic or scenic resources. A new dry storage facility would not be visible from any onsite or offsite public access roads. Potential soil erosion and dust generation associated with construction-related activities would be controlled by the implementation of best-management practices. Any visibility impacts from fugitive dust generation by construction-related activities should be insignificant and short term. Facility operations associated with the new dry storage of foreign research reactor spent nuclear fuel should not generate any atmospheric emissions which would reduce area visibility.

#### **F.4.1.2.1.5 Geology**

There are no unique geologic features or minerals of economic value on the Savannah River Site that would be adversely impacted by site development. Construction of a new dry storage facility would result in localized impacts to surficial soils and would necessitate the clearing and grading of 3.7 ha (9 acres).

Site preparation, land shaping and grading activities associated with construction would present a slight to moderate erosion hazard, which would be controlled and minimized by implementing best-management practices. The operation of the new dry storage facility would have no effect on the geologic characteristics at the Savannah River Site.

#### F.4.1.2.1.6 Air Quality

*Nonradiological Emissions:* Potential air quality impacts associated with construction-related activities include the generation of fugitive dust (particulate matter), smoke from earth moving and clearing operations, and emissions from the construction equipment. Sources of fugitive dust include:

- transfer of soil to and from haul trucks and storage piles;
- turbulence created by construction vehicles moving over cleared, unpaved surfaces; and
- wind-induced erosion of exposed surfaces.

Cleared vegetation would be burned at the construction site rather than hauled to a landfill. The open burning of this material is not expected to adversely impact ambient air quality at the Savannah River Site. As shown in Table F-25, air quality impacts associated with construction-related activities would be minimal and compliance with Federal and State ambient air quality standards would not be adversely affected. Therefore, construction activities would not be expected to have any detrimental effect on the health and safety of the general population.

**Table F-25 Estimated Maximum Concentrations of Criteria Pollutants at the Savannah River Site Attributable to New Dry Storage Construction**

<i>Pollutant</i>	<i>Averaging Time</i>	<i>Ambient Standard<sup>a</sup></i>	<i>Baseline Concentration<sup>b</sup></i>	<i>Construction Activities</i>
<i>Savannah River Site Boundary (<math>\mu\text{g}/\text{m}^3</math>):</i>				
• Total Suspended Particulate (TSP)	Annual	75	11	0.002 - 0.003
• Particulate Matter (PM <sub>10</sub> ), Daily	24-hr	150	56	0.1
• Particulate Matter (PM <sub>10</sub> ), Daily	Annual	50	2.7	0.003

<sup>a</sup> Source: (DOE, 1995g)

<sup>b</sup> Baseline values due to actual emissions from all the Savannah River Site sources during 1990 plus sources permitted through 1992

No nonradiological air emissions would be expected during operation of a new dry storage facility. Any emissions associated with new dry storage would be directly attributable to front-end wet storage activities only.

*Radiological Emissions:* No radiological emissions would be produced during construction of a dry new storage facility.

Based on fuel drying and storage operations conducted at the Idaho National Engineering Laboratory, potential atmospheric releases from the spent nuclear fuel storage facility would consist of minor amounts of particulate radioactive material and larger amounts of gaseous fission products that could escape from the fuel through cladding defects. The majority of radioactive material responsible for fuel and cask internal surface contamination consists of activation products that plate out on the spent nuclear fuel assemblies during reactor operation. This material is dependent on corrosion of structural materials and

generally consists of radionuclides, such as  $^{58}\text{Co}$ ,  $^{60}\text{Co}$ ,  $^{59}\text{Fe}$ , etc. This contamination activity would have to be controlled during the cask opening and fuel handling operations to prevent internal personnel exposures. Proper facility ventilation (designed to provide airflow from areas of low contamination to progressively high contamination) would help provide contamination control. High-Efficiency Particulate Air filters in the facility exhaust would reduce the airborne effluent quantities of this particulate material to quantities that are well within the prescribed limits.

Cask opening and fuel drying operations may also be responsible for the release of significant amounts of  $^3\text{H}$ ,  $^{85}\text{Kr}$ , and minor amounts of  $^{129}\text{I}$ . The amounts of these radionuclides released during the cask opening operation depend on the following parameters: (1) the number of spent nuclear fuel clad defects; (2) the spent nuclear fuel material and the diffusion rate of these radionuclides through the fuel matrix for the fuel temperature while in the cask; and (3) the time that the spent nuclear fuel is contained within the cask before opening.

Similarly, for fuel drying operations, the temperature of the drying gas (as well as the parameters discussed above) would cause quantities of  $^3\text{H}$ ,  $^{85}\text{Kr}$ , and  $^{129}\text{I}$  to be released from the fuel. Charcoal or silver zeolite filters could be used to remove the  $^{129}\text{I}$  from the exhaust, but the  $^3\text{H}$  and  $^{85}\text{Kr}$ , being gases, or in a vapor state for the case of tritiated water, would be exhausted to the atmosphere. During spent nuclear fuel storage small amounts of the gaseous/volatile radionuclides are expected to be released to the environment based on the fuel matrix, clad defects, and storage temperature. Release rates would decrease with storage time due to radioactive decay. It is anticipated that the fuel drying operation would be responsible for the most significant release of these gaseous/volatile radionuclides to the environment.

Radiological emissions from the operation of a new dry storage facility were calculated based on the methodology and assumptions discussed in Section F.6. The radiological consequences of air emissions are discussed in Section F.4.1.2.1.11. The annual emission releases from the dry storage facility during receipt and unloading and storage are provided in Section F.6.6.1.

#### **F.4.1.2.1.7 Water Resources**

The water usage during construction of a new dry storage facility is estimated to be about 7.75 million l (2 million gal). During operations, annual water consumption would be 2.1 million l (550,000 gal) for receipt and handling and 0.4 million l (109,000 gal) for storage. With an annual average water usage of approximately 88,200 million l (23,300 million gal) for the Savannah River Site, these amounts represent no more than a 0.002 percent increase in annual water usage. Therefore, a new dry storage facility would have minimal impact on water resources at the Savannah River Site.

Best-management practices during construction would prevent sediment runoff or spills of fuels or chemicals. Therefore, construction activities should have no impact on water quality at the Savannah River Site. The impact on water quality during operations would also be negligible. Existing water treatment facilities at the Savannah River Site could accommodate any new domestic and process wastewater streams from a new dry storage facility. The expected total flow volumes at the Savannah River Site would still be well within the design capacities of treatment systems at the Savannah River Site. A new dry storage facility would meet National Pollutant Discharge Elimination System limits and reporting requirements, so no impact on the water quality of receiving streams is expected.

#### **F.4.1.2.1.8 Ecology**

*Terrestrial Resources:* The two proposed locations for new spent nuclear fuel management facilities encompass approximately 60-plus ha (150-plus acres) of undeveloped forest land. Surface vegetation consists primarily of upland pine stands. Loblolly and slash pine dominate, but small pockets of hardwoods (oaks, hickory, sweetgum, and yellow poplar) are also evident. The locations possess suitable habitat for white-tailed deer and feral hogs, as well as other faunal species common to the mixed pine/hardwood forests of South Carolina. The locations contain no suitable habitat for the various threatened and endangered species found on the Savannah River Site. The construction of a new dry storage facility would necessitate the clearing of 3.7 ha (9 acres) and is therefore not expected to significantly affect the terrestrial ecology of the area.

*Wetlands:* Dry storage of foreign research reactor spent nuclear fuel would not adversely impact wetlands. Although two small wetland areas are located along the southeastern perimeters of the potential storage locations, there is sufficient land area available within these locations to avoid these critical habitats. The implementation of best-management practices to control surface runoff and sedimentation would ensure the protection of wetlands and the aquatic ecosystem during construction activities.

*Threatened and Endangered Species:* The potential locations contain no suitable habitat for threatened, endangered, or candidate species known to occur on or near the Savannah River Site (DOE, 1995g). The southern bald eagle and wood stork feed and nest near wetlands, streams, and reservoirs, and thus would not be attracted to the highly industrialized foreign research reactor spent nuclear fuel management sites. Red-cockaded woodpeckers prefer open pine forests with mature trees greater than 70 years old for nesting and 30 years old for foraging. It is not believed that this species utilizes the relatively young pine stands (5 to 40 years of age) present within the potential storage locations. The nearest red-cockaded woodpecker colony is located across Upper Three Runs Creek, approximately 3.2 km (2 mi) north of H-Area. DOE has begun consultations with the U.S. Fish and Wildlife Service to determine the potential for endangered species to be affected, as required by the Endangered Species Act. Impacts to threatened and endangered species are not anticipated.

#### **F.4.1.2.1.9 Noise**

Noise generated onsite by construction or operation of a new dry storage facility should not adversely affect the public or the Savannah River Site environment. Noise generated by construction would be site specific and short lived. A small number of new construction jobs would be generated, but the resultant temporary increase in worker and materials traffic is expected to be insignificant compared to existing baseline traffic loads. Noise generated by operation would not significantly impact the environment because the facility would be located adjacent to previously developed, industrialized areas. The number of daily freight trains in the region and through the site (approximately 13) are not expected to change as a result of dry storage. There may be a slight increase in truck traffic to and from the potential storage locations, but this is not expected to result in a perceptible increase in traffic noise or any change in community reaction to noise along the major access routes to the Savannah River Site.

#### **F.4.1.2.1.10 Traffic and Transportation**

Construction materials, wastes, and excavated materials would be transported both onsite and offsite. These activities would result in increases in operation of personal-use vehicles by commuting construction

workers, commercial truck traffic, and in traffic associated with the daily operations of the Savannah River Site. Again, traffic congestion would not be a significant problem. As long as commercial trucks are complying with the Federal and State loading and speed regulations, truck traffic would not significantly damage the roadbed.

Traffic due to operations of a new dry storage facility would not increase site levels because the required workers would be drawn from the existing the Savannah River Site labor force.

#### F.4.1.2.1.11 Occupational and Public Health and Safety

*Emissions Related Impacts:* Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Savannah River Site would be attributed to emissions of radioactive material that could be carried by the wind offsite. The general public would be too far from the locations where handling activities or storage take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and resulting doses are discussed in Section F.6 of this appendix. Table F-26 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Savannah River Site. Integrated doses for the duration of a specific implementation period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-26 Annual Public Impacts for Foreign Research Reactor Spent Nuclear Fuel Receipt and Storage at Savannah River Site (New Dry Storage)**

<i>Facility</i>	<i>MEI Dose (mrem/yr)</i>	<i>MEI Risk (LCF/yr)</i>	<i>Population Dose (person-rem/yr)</i>	<i>Population Risk (LCF/yr)</i>
Receipt/Unloading at: • New Dry Storage Facility	0.00018	$9.0 \times 10^{-11}$	0.0086	0.0000043
Storage at: • New Dry Storage Facility	0	0	0	0

*Handling-Related Impacts:* Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask), transferring the spent nuclear fuel from one facility to another, or preparing the spent nuclear fuel for shipment offsite. Analysis option 1B involves the receipt of 644 shipments of foreign research reactor spent nuclear fuel into an existing wet storage facility (RBOF and/or L-Reactor disassembly basin) during Phase 1, the preparation of 161 transportation casks for shipment to a dry storage facility at the end of Phase 1, and the receipt of 193 shipments of foreign research reactor spent nuclear fuel directly from the ports to the new dry storage facility after Phase 1 operations. It was assumed that at the end of a 10-year period, the foreign research reactor spent nuclear fuel would have decayed sufficiently to be accommodated in larger capacity transportation casks, such as those currently used in the United States for commercial spent nuclear fuel. For the purpose of this analysis, the transportation casks used for intrasite shipping are assumed to have a capacity four times as large as the capacity of the transportation casks used for the marine transport of the foreign research reactor spent nuclear fuel to the United States. Doses were calculated for the dry vault and dry cask designs. The assumptions and methodologies used to calculate the doses to a working crew associated with the handling activities of the foreign research reactor spent nuclear fuel are described in Section F.5 of this appendix.

Table F-27 presents the population dose that would be received by the members of the working crew and the associated risk if that working crew handled the total number of transportation casks at the Savannah River Site. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the administrative or regulatory limit at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this limit, he or she would be rotated into a different job to prevent further exposure. This regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent.

**Table F-27 Handling-Related Impacts to Workers at the Savannah River Site (New Dry Storage)**

	<i>Worker Population Dose (person-rem)</i>			<i>Worker Population Risk (LCF)</i>		
	<i>RBOF/L-Reactor</i>	<i>New Dry Storage Cask</i>	<i>New Dry Storage Vault</i>	<i>RBOF/L-Reactor</i>	<i>New Dry Storage Cask</i>	<i>New Dry Storage Vault</i>
Phase 1	250	NA	NA	0.10	NA	NA
Phases 1 and 2	NA	416	363	NA	0.17	0.15

NA = Not Applicable

#### F.4.1.2.1.12 Material, Utility, and Energy Requirements

Construction of a new dry storage facility at the Savannah River Site would consume 21,800 m<sup>3</sup> (28,500 yd<sup>3</sup>) of concrete and 5,200 metric tons (5,750 tons) of steel. The total energy and water requirements during construction are estimated to be 835,000 l (221,000 gal) for fuel; and 7.75 million l (2 million gal) for water. The annual utility and energy requirements during operations are shown in Table F-28. These requirements represent a small percent of current requirements for the Savannah River Site. No new generation or treatment facilities would be necessary, and connections to existing networks would require only short tie-in lines. Increases in consumption would be minimal because overall activity on the Savannah River Site is expected to decrease due to changes in site mission and a general reduction in employment.

**Table F-28 Annual Utility and Energy Requirements for New Dry Storage at the Savannah River Site**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>Dry Storage Usage</i>	<i>Percent Increase</i>
Electricity (MW-hr/yr)	659,000	800 - 1,000	0.15 percent
Fuel (l/yr)	28,400,000	0	0 percent
Water (l/yr)	88,200,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.002 percent <sup>a</sup> 0.00046 percent <sup>b</sup>

<sup>a</sup> During receipt and handling.

<sup>b</sup> During storage.

#### F.4.1.2.1.13 Waste Management

Construction of a new dry storage facility at the Savannah River Site would generate approximately 1,800 m<sup>3</sup> (2,400 yd<sup>3</sup>) of debris. The annual quantities of waste generated during operations are shown in Table F-29. These quantities represent a very small percent increase above current levels at the Savannah River Site. Existing waste management storage and disposal activities at the Savannah River Site could accommodate the waste generated by a new dry storage facility. Therefore, the impact of this waste on the existing Savannah River Site waste management capacities would be minimal.

**Table F-29 Annual Waste Generated from New Dry Storage at the Savannah River Site**

<i>Waste Form</i>	<i>Baseline Site Generation</i>	<i>Dry Storage Generation</i>	<i>Percent Increase</i>
High-Level Waste (m <sup>3</sup> /yr)	127,400 <sup>a</sup>	none	0 percent
Transuranic Waste (m <sup>3</sup> /yr)	760	none	0 percent
Solid Low-Level Waste (m <sup>3</sup> /yr)	19,750	22 <sup>b</sup> 1 <sup>c</sup>	0.11 percent <sup>b</sup> 0.005 percent <sup>c</sup>
Wastewater (l/yr)	690,000,000	1,590,000 <sup>b</sup> 400,000 <sup>c</sup>	0.21 percent <sup>b</sup> 0.06 percent <sup>c</sup>

<sup>a</sup> Total inventory (m<sup>3</sup>) at the Savannah River Site

<sup>b</sup> During receipt and handling

<sup>c</sup> During storage

#### F.4.1.2.2 Wet Storage

Analysis option 1C is associated with the construction and operation of a new wet storage facility or the modification and operation of BNFP at the Savannah River Site (Implementation Alternative 5 to Management Alternative 1). The environmental impacts from the modification of the BNFP would be bounded by the impacts associated with the construction of a new wet storage facility.

##### F.4.1.2.2.1 Land Use

A new wet storage facility would be located in one of two 60-plus ha (150-plus acres) undeveloped areas near the H- and P-areas, respectively. Predominant land use at both areas is managed timber land. Construction activities, including laydown areas, would disturb 2.8 ha (7 acres) of land. This represents less than 5 percent of the available space at either area. A new wet storage facility would occupy 3,800 m<sup>2</sup> (41,000 ft<sup>2</sup>) of land and would move 18,000 m<sup>3</sup> (24,000 yd<sup>3</sup>) of soil. Neither construction nor operation of a new wet storage facility at either area would significantly impact land use patterns on the Savannah River Site.

##### F.4.1.2.2.2 Socioeconomics

As discussed in Section F.3.2 the total capital cost of a new wet storage facility is estimated to be \$449 million. Construction activities are projected to take 4 years. Assuming that the capital cost is evenly distributed over this 4-year period, the annual expenditures would be about \$112.2 million. This represents approximately 9.4 percent of the estimated FY 1995 total expenditures for the Savannah River Site (1,198 million). The relative socioeconomic impact from annual construction expenditures on the region of influence would be small but positive. The annual operations costs of a new wet storage facility

are estimated to be \$23.3 million for receipt and handling and \$3.5 million for storage. These costs represent about 1.9 percent and 0.3 percent of FY 1995 total expenditures for the Savannah River Site. The relative socioeconomic impact from annual operation expenditures on the region of influence would be small.

Direct employment associated with construction of a new wet storage facility is estimated to be 157 persons. The relative socioeconomic impact from direct construction employment on the region of influence would be small. In addition, when compared to the projected FY 1995 work force at the Savannah River Site of approximately 20,000 persons, the relative socioeconomic impact of this temporary increase in construction employment would be insignificant. Direct employment associated with operations of a new wet storage facility is estimated to be 30 persons. The relative socioeconomic impact of this increase in operations employment would be small to both the region of influence and the Savannah River Site.

#### **F.4.1.2.2.3 Cultural Resources**

Impacts to cultural resources would be the same as for new dry storage (Section F.4.1.2.1.3).

#### **F.4.1.2.2.4 Aesthetic and Scenic Resources**

Impacts to aesthetic and scenic resources would be the same as for new dry storage (Section F.4.1.2.1.4).

#### **F.4.1.2.2.5 Geology**

Impacts to geology would be the same as for new dry storage (Section F.4.1.2.1.5).

#### **F.4.1.2.2.6 Air Quality**

*Nonradiological Emissions:* Construction of a new wet storage facility would necessitate the clearing and grading of approximately 2.8 ha (7 acres) of land. In comparison, approximately 3.7 ha (9 acres) of land would be disturbed by new dry storage construction. Therefore, air quality impacts associated with wet storage construction would be bound by those associated with new dry storage construction, as presented in Table F-25.

Operations-related impacts associated with wet storage would be similar to those discussed under existing facilities.

*Radiological Emissions:* Incident-free airborne releases from a new wet storage facility would be limited to radioactive noble gases and some radioactive iodine which could be released from the stored fuel prior to canning. The airborne materials released to the building atmosphere during incident-free operations would be filtered by the building heating and ventilation system. Radioactive and nonradioactive effluent gases would be routed through double-banked high-efficiency particulate air filters prior to release to the environment through an exhaust air system. The high-efficiency particulate air filter would have a minimum efficiency of 99.97 percent for 0.3-micron diameter particulates and would allow in-place dioctyl phthalate testing.

The new wet storage facility would discharge all ventilated gas, except truck exhaust, to the facility's exhaust system. The truck exhaust would be discharged directly to the environment during cask off-loading operations in the truck receiving area. The exhaust air system would employ a detector to monitor  $^{137}\text{Cs}$ . For other building areas which would be sources of airborne radioactive contamination, the heating, ventilation, and air conditioning system would be designed to maintain airflow from areas of low potential contamination into areas of higher potential contamination. These airborne effluents would be required to be below the radioactivity concentration guides listed in DOE Order 5480.1B for both onsite and offsite concentrations (DOE, 1989b).

Air emissions from the new wet storage facility are expected to be similar to the air emissions from the IFSF at the Idaho National Engineering Laboratory. The annual air emission for the IFSF was designed to result in ground-level concentrations of less than 0.003 percent of DOE Order 5480.1B limits for uncontrolled areas.

Radiological emissions from the operation of the new wet storage facility were calculated based on the methodology and assumptions used in Appendix F, Section F.6. The annual emission releases from the wet storage facility during the receipt and unloading, and storage are provided in Section F.6.6.1.

#### **F.4.1.2.2.7 Water Resources**

The annual water usage during construction and operation of a new wet storage facility is estimated to be about 1.9 million l (502,000 gal) and 2.7 million l (720,000 gal), respectively. With an annual average water usage of approximately 88,200 million l (23,300 million gal) for the Savannah River Site, these amounts represent an increase of less than 0.01 percent for both. Therefore, a new wet storage facility would have minimal impact on water resources at the Savannah River Site.

Best-management practices during construction would prevent sediment runoff or spills of fuels or chemicals. Therefore, construction activities should have no impact on water quality at the Savannah River Site. The impact on water quality during operations would also be negligible. Existing water treatment facilities at the Savannah River Site could accommodate any new domestic and process wastewater streams from a new wet storage facility. The expected total flow volumes at the Savannah River Site would still be well within the design capacities of treatment systems at the Savannah River Site. A new wet storage facility would meet National Pollutant Discharge Elimination System limits and reporting requirements, so no impact on the water quality of receiving streams is expected.

#### **F.4.1.2.2.8 Ecology**

Impacts to the ecology would be the same as for new dry storage (Section F.4.1.2.1.8).

#### **F.4.1.2.2.9 Noise**

Impacts from noise would be the same as for new dry storage (Section F.4.1.2.1.9).

#### **F.4.1.2.2.10 Traffic and Transportation**

Impacts from traffic and transportation would be the same as for new dry storage (Section F.4.1.2.1.10).

### F.4.1.2.2.11 Occupational and Public Health and Safety

**Emission-Related Impacts:** Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Savannah River Site would be attributed to emissions of radioactive material that could be carried by wind offsite. The general public would be too far from the locations where handling activities or storage take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and resulting doses are discussed in Section F.6 of this appendix. Table F-30 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Savannah River Site. Integrated doses for the duration of a specific implementation period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-30 Annual Public Impacts for Receipt and Storage of Foreign Research Reactor Spent Nuclear Fuel at the Savannah River Site (Implementation Alternative 5 of Management Alternative 1)**

Facility	MEI Dose (mrem/yr)	MEI Risk (LCF/yr)	Population Dose (person-rem/yr)	Population Risk (LCF/yr)
Receipt/Unloading at:				
• BNFP	0.00065	$3.3 \times 10^{-10}$	0.0045	0.0000023
• New Wet Storage Facility	0.00011	$5.5 \times 10^{-11}$	0.0057	0.0000028
Storage at:				
• BNFP	$7.5 \times 10^{-9}$	$3.8 \times 10^{-15}$	$4.8 \times 10^{-8}$	$2.4 \times 10^{-11}$
• New Wet Storage Facility	$1.2 \times 10^{-9}$	$6.0 \times 10^{-16}$	$6.2 \times 10^{-8}$	$3.1 \times 10^{-11}$

**Handling-Related Impacts:** Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask), transferring the spent nuclear fuel from one facility to another, or preparing the spent nuclear fuel for shipment offsite. Analysis option 1C involves the receipt of 644 shipments of foreign research reactor spent nuclear fuel into an existing wet storage facility (RBOF and/or L-Reactor disassembly basin) during Phase 1, the preparation of 161 transportation casks for shipment to a wet storage facility at the end of Phase 1, and the receipt of 193 shipments of foreign research reactor spent nuclear fuel directly from the ports into the new wet storage facility after Phase 1 operations. It was assumed that at the end of a 10-year period, the foreign research reactor spent nuclear fuel would have decayed sufficiently to be accommodated in larger capacity transportation casks, such as those currently used in the United States for commercial spent nuclear fuel. For the purpose of this analysis, the transportation casks used for intrasite shipping are assumed to have a capacity four times as large as the capacity of the transportation casks used for the marine transport of the foreign research reactor spent nuclear fuel to the United States. The assumptions and methodologies used to calculate the doses to a working crew associated with the handling activities of the foreign research reactor spent nuclear fuel are described in Section F.5 of this appendix.

Table F-31 presents the population dose that would be received by the members of the working crew and the associated risk if that working crew handled the total number of transportation casks at the Savannah River Site. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the administrative limits at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this

limit, he or she would be rotated into a different job to prevent further exposure. This regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent.

**Table F-31 Handling-Related Impacts to Workers at the Savannah River Site  
(Implementation Alternative 5 of Management Alternative 1)**

<i>Facility</i>	<i>Worker Population Dose (person-rem)</i>	<i>Worker Population Risk (LCF)</i>
Phase 1: RBOF/L-Reactor Basin	250	0.10
Phase 1 and Phase 2: New Wet Storage Facility	360	0.14
Phase 1: RBOF/L-Reactor Basin	250	0.10
Phase 1 and Phase 2: BNFP	360	0.14
Phase 1: RBOF/L-Reactor Basin	250	0.10
Phase 1 and Phase 2: BNFP <sup>a</sup>	310	0.12

<sup>a</sup> Assumes that BNFP would be ready in 5 years instead of 10 years.

#### F.4.1.2.2.12 Material, Utility, and Energy Requirements

Construction of a new wet storage facility at the Savannah River Site would consume 12,400 m<sup>3</sup> (16,260 yd<sup>3</sup>) of concrete and 3,100 metric tons (3,443 tons) of steel. The total energy and water requirements during construction are estimated to be 600,000 l (159,000 gal) for fuel, and 4.4 million l (1.2 million gal) for water. The annual utility and energy requirements during operations are shown in Table F-32. These requirements represent a small percent of current requirements for the Savannah River Site. No new generation or treatment facilities would be necessary, and connections to existing networks would require only short tie-in lines. Increases in consumption would be minimal because overall activity on the Savannah River Site is expected to decrease due to changes in site mission and a general reduction in employment.

**Table F-32 Annual Utility and Energy Requirements for New Wet Storage at the  
Savannah River Site (Implementation Alternative 5 of Management Alternative 1)**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>Wet Storage Usage</i>	<i>Percent Increase</i>
Electricity (MW-hr/yr)	659,000	1,000 - 1,500	0.23 percent
Fuel (l/yr)	28,400,000	0	0 percent
Water (l/yr)	88,200,000,000	2,700,000 <sup>a</sup> 1,500,000 <sup>b</sup>	0.003 percent 0.001 percent

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

#### F.4.1.2.2.13 Waste Management

Construction of a new wet storage facility would generate 2,600 m<sup>3</sup> (10,300 yd<sup>3</sup>) of debris. The annual quantities of waste generated during operations are shown in Table F-33. These quantities represent a very small percent increase in current levels at the Savannah River Site. Existing waste management storage and disposal activities at the Savannah River Site could accommodate the waste generated by a new wet

**Table F-33 Annual Waste Generated from New Wet Storage at the Savannah River Site (Implementation Alternative 5 of Management Alternative 1)**

<i>Waste Form</i>	<i>Baseline Site Generation</i>	<i>Wet Storage Generation</i>	<i>Percent Increase</i>
High-Level (m <sup>3</sup> /yr)	127,400 <sup>a</sup>	none	0 percent
Transuranic (m <sup>3</sup> /yr)	760	none	0 percent
Solid Low-Level (m <sup>3</sup> /yr)	19,750	16 <sup>b</sup> 1 <sup>c</sup>	0.08 percent 0.005 percent
Wastewater (l/yr)	690,000,000	1,590,000 <sup>b</sup> 400,000 <sup>c</sup>	0.23 percent 0.06 percent

<sup>a</sup> Total inventory (m<sup>3</sup>) at the Savannah River Site.

<sup>b</sup> During receipt and handling

<sup>c</sup> During storage

storage facility. Therefore, the impact of this waste on the existing Savannah River Site waste management capacities would be minimal.

#### **F.4.1.3 Accident Analysis**

An evaluation of incident-free operations and hypothetical accidents at the Savannah River Site is presented here, based on the methodology presented in Appendix F, Section F.6. The evaluation assessed the possible radiation exposure to individuals and general population due to the release of radioactive materials. The analyses are based on the same operations carried out at the different potential storage locations and the same accidents at any of the sites evaluated.

The radiation doses to the following individuals and the general population are calculated for accident conditions at the spent nuclear fuel storage facility:

- **Worker:** An individual located 100 m (330 ft) from the radioactive material release point. For elevated release, the worker dose was calculated at a point of maximum dose. The distance at which the maximum dose occurs is frequently greater than 100 m (330 ft) for elevated release. The direction to the worker was chosen as the direction to the maximally exposed sector. The dose to the worker is calculated for the 50th-percentile meteorological condition (DOE, 1992a).
- **Maximally Exposed Offsite Individual (MEI):** A theoretical individual living at the storage site boundary receiving the maximum exposure. The individual is assumed to be located in a direction downwind from the release point. The dose to the MEI is shown for the 95th-percentile meteorological condition.
- **Nearest Public Access Individual (NPAI).** An individual stranded on a highway or public access road near to the facility at the time of an accident. The distance to the NPAI was chosen as the distance to the nearest public access point; the direction was chosen as the direction to that point. The dose to the NPAI is shown for the 95th-percentile meteorological condition.
- **General Population Within an 80 km (50 mi) Radius of the Facility:** The dose calculations are performed for the direction downwind from the release point that results in highest dose to the public. The dose to the population is shown for the 95th-percentile meteorological condition.

The radiation dose to individuals and the public resulting from exposure to radioactive contamination was calculated using external (direct exposure), inhalation, and ingestion pathways. Dispersion in air from point of release was estimated with both 50th-percentile and 95th-percentile meteorological conditions. The 50th-percentile condition represents the median meteorological condition. The 95th-percentile condition is defined as that condition which is not exceeded more than 5 percent of the time, and is more conservative than the 50th-percentile condition.

The ingestion dose is calculated by considering that the individual and the public would consume contaminated food produced in the vicinity [up to 80 km (50 mi)] of the accident. This is conservative, and it is expected that continued consumption of contaminated food products by the public would be suspended after a protective action guideline is reached. In 1991, the U.S. Environmental Protection Agency recommended protective action guidelines in the range of one to five rem whole-body exposure (EPA, 1991). To ensure a consistent analytical basis, no reduction of exposure due to a protective action guideline was used in this analysis.

Accidents considered for detailed analysis are similar to those analyzed in the Programmatic SNF&INEL Final EIS. The selection of accidents was based on the following considerations:

- Accidents in the Programmatic SNF&INEL Final EIS were reviewed to select reasonably foreseeable accidents. They are: (1) criticality caused by human error during operation, equipment failure, or earthquake; (2) mechanical damage to foreign research reactor spent nuclear fuel during examination and preparation (cropping off the aluminum and nonfuel end of a spent nuclear fuel element); and (3) accident involving an impact by either an internal or an external initiator with and without an ensuing fire.

Six accident scenarios were evaluated at each storage location using identical source terms (estimated amounts of radioactive material released during postulated accidents). The wet pool accidents are assumed to be cutting into the fuel region or mechanical damage due to operator error, an accidental criticality, and an aircraft crash into the water pool facility. The dry storage accidents are assumed to be cutting into the fuel region or mechanical damage during examination work and handling in a dry cell, dropping of a fuel cask, and an aircraft crash with an ensuing fire.

Table F-34 presents frequency and consequences in terms of mrem or person-rem, of postulated accidents to the offsite MEI, NPAI, and offsite population for the 95th-percentile meteorological conditions using the assumptions and input values discussed above. The worker doses are calculated only for the 50th-percentile meteorology. This is an individual assumed to be 100 m (330 ft) downwind of the accident. DOE did not estimate the worker population dose.

Multiplying the frequency of each accident times its consequences at the Savannah River Site and converting the radiation doses to LCF yields the annual risks associated with each potential accident at the Savannah River Site. These annual risks are multiplied by the maximum duration of the policy at each site to obtain conservative estimates of risks for the entire program at the Savannah River Site. These risk estimates are presented in Table F-35.

Table F-36 presents the frequency and consequences of the accidents analyzed for the Savannah River Site for wet storage (Implementation Alternative 5 of Management Alternative 1). Multiplying the frequency of each accident times its consequences at the Savannah River Site and converting the radiation doses to LCF yields the annual risks associated with each potential accident at the Savannah River Site. These annual risks are multiplied by the maximum duration of this implementation alternative at the Savannah

**Table F-34 Frequency and Consequences of Accidents at the Savannah River Site**

	Frequency (per year)	Consequences			
		MEI (mrem)	NPAI (mrem)	Population (person-rem)	Worker (mrem)
Dry Storage Accidents - New					
• Spent Nuclear Fuel Assembly Breach	0.16	0.24	0.068	9.2	28
• Dropped Fuel Cask	0.0001	0.018	0.00034	0.55	0.28
• Aircraft Crash w/Fire	1 x 10 <sup>-6</sup>	40	0.29	1300	120
Wet Storage Accidents at RBOF					
• Spent Nuclear Fuel Assembly Breach	0.16	0.0070	0.00039	0.23	0.14
• Accidental Criticality	0.0031	130	44	4,800	16,000
• Aircraft Crash	1 x 10 <sup>-6</sup>	4.1	0.98	150	400
Wet Storage Accidents at L-Reactor Basin					
• Spent Nuclear Fuel Assembly Breach	0.16	0.0093	0.00097	0.14	0.11
• Accidental Criticality	0.0031	170	120	3,000	14,000
• Aircraft Crash	1 x 10 <sup>-6</sup>	4.2	2.6	93	70

**Table F-35 Annual Risks of Accidents at the Savannah River Site**

	Risks			
	MEI (LCF/yr)	NPAI (LCF/yr)	Population (LCF/yr)	Worker (LCF/yr)
<i>Dry Storage Accidents - New</i>				
• Spent Nuclear Fuel Assembly Breach	$1.9 \times 10^{-8}$	$5.5 \times 10^{-9}$	0.00075	0.0000018
• Dropped Fuel Cask	$9.0 \times 10^{-13}$	$1.7 \times 10^{-14}$	$2.8 \times 10^{-8}$	$1.1 \times 10^{-11}$
• Aircraft Crash w/Fire	$2.0 \times 10^{-11}$	$1.5 \times 10^{-13}$	$6.5 \times 10^{-7}$	$4.8 \times 10^{-11}$
<i>Wet Storage Accidents at RBOF</i>				
• Spent Nuclear Fuel Assembly Breach	$5.5 \times 10^{-10}$	$3.1 \times 10^{-11}$	0.000019	$8.8 \times 10^{-10}$
• Accidental Criticality	$2.0 \times 10^{-7}$	$7.0 \times 10^{-8}$	0.0074	0.000020
• Aircraft Crash	$2.1 \times 10^{-12}$	$4.9 \times 10^{-13}$	$7.5 \times 10^{-8}$	$1.6 \times 10^{-10}$
<i>Wet Storage Accidents at L-Reactor Basin</i>				
• Spent Nuclear Fuel Assembly Breach	$7.4 \times 10^{-10}$	$8.0 \times 10^{-11}$	0.000011	$7.1 \times 10^{-9}$
• Accidental Criticality	$2.6 \times 10^{-7}$	$1.9 \times 10^{-7}$	0.0047	0.000017
• Aircraft Crash	$2.1 \times 10^{-12}$	$1.3 \times 10^{-12}$	$4.7 \times 10^{-8}$	$2.8 \times 10^{-11}$

**Table F-36 Frequency and Consequences of Accidents at Savannah River Site  
(Implementation Alternative 5 of Management Alternative 1)**

	Frequency (per year)	Consequences			
		MEI (mrem)	NPAI (mrem)	Population (person-rem)	Worker (mrem)
Wet Storage Facility - New					
• Spent Nuclear Fuel Assembly Breach	0.16	0.0070	0.00039	0.23	0.14
• Accidental Criticality	0.0031	17	9.5	370	1,600
• Aircraft Crash	1 x 10 <sup>-6</sup>	4.1	0.98	150	400
BNFP					
• Spent Nuclear Fuel Assembly Breach <sup>a</sup>	0.16	0.018	0.00099	0.028	0.0008
• Accidental Criticality <sup>a</sup>	0.0031	80	75	44	75
• Aircraft Crash	1 x 10 <sup>-6</sup>	92	31	23	70

<sup>a</sup> Emissions would be released through a tall stack.

River Site to obtain conservative estimates of risks at the Savannah River Site. Table F-37 presents the risk estimates from this implementation alternative.

**Table F-37 Annual Risks of Accidents at the Savannah River Site (Implementation Alternative 5 of Management Alternative 1)**

	<i>Risks</i>			
	<i>MEI (LCF/yr)</i>	<i>NPAI (LCF/yr)</i>	<i>Population (LCF/yr)</i>	<i>Worker (LCF/yr)</i>
<i>Wet Storage Facility - New</i>				
• Spent Nuclear Fuel Assembly Breach	$5.5 \times 10^{-10}$	$3.1 \times 10^{-11}$	0.000019	$8.8 \times 10^{-10}$
• Accidental Criticality	$2.7 \times 10^{-8}$	$1.5 \times 10^{-8}$	0.00060	0.0000020
• Aircraft Crash	$2.1 \times 10^{-12}$	$4.9 \times 10^{-13}$	$7.5 \times 10^{-8}$	$1.6 \times 10^{-10}$
<i>BNFP</i>				
• Spent Nuclear Fuel Assembly Breach <sup>a</sup>	$2.8 \times 10^{-9}$	$8.0 \times 10^{-11}$	0.0000023	$5.2 \times 10^{-11}$
• Accidental Criticality <sup>a</sup>	$1.3 \times 10^{-7}$	$1.2 \times 10^{-7}$	0.000070	$9.2 \times 10^{-8}$
• Aircraft Crash <sup>a</sup>	$4.6 \times 10^{-10}$	$1.6 \times 10^{-11}$	$1.2 \times 10^{-8}$	$2.8 \times 10^{-10}$

<sup>a</sup> Emissions would be released through a tall stack.

#### F.4.1.3.1 Secondary Impact of Radiological Accidents at the Savannah River Site

In the event of an accidental release of radioactivity, there is a potential for impacts to land uses, cultural resources, water quality, ecology, national defense, and local economies (secondary impacts). For this analysis, secondary impacts of radiological accidents involving foreign research reactor spent nuclear fuel have been qualitatively assessed based on the results of the accident calculations presented in Section F.4.1.3. Radiological accidents that would result in doses to the MEI of less than the annual Federal radiological exposure limit for the public of 100 mrem (10 CFR Part 20) were considered to have no secondary impacts.

The MEI dose provides a measure of the air concentration and radionuclide deposition at the receptor location. As such, it can be used to express the level of contamination from a given radiological accident. In estimating the human health effects from radiological exposure (as presented in Section F.4.1.3), the MEI dose evaluates four pathways: (1) air immersion, (2) ground surface, (3) inhalation, and (4) ingestion. In estimating the environmental effects from radiological exposure, however, only the air immersion and ground surface pathways need be considered.

At the Savannah River Site, the radiological accident with the highest MEI dose is the accidental criticality at a wet storage facility (Table F-34). For this accident, the MEI dose would be 170 mrem. For the air immersion and ground surface pathways only, the dose would be 50 mrem, (Table F-115A) which is lower than the 100 mrem limit used in this analysis. Local contamination would be likely around the dry storage facility, but is expected to be contained entirely within the boundaries of the Savannah River Site. Cleanup activities should be small and any impacts to land uses, cultural resources, water quality, and ecology would be reversible. No impacts to national defense or local economies would be expected.

#### F.4.1.4 Cumulative Impacts at the Savannah River Site

This section presents the cumulative impacts of the proposed action, potential impacts of other major contemplated DOE actions, and other offsite (non-DOE) facility impacts at the Savannah River Site. A major portion of the presentation is based on information included in the Interim Management of Nuclear Materials Final EIS for the Savannah River Site, issued in October 1995 (DOE, 1995b). The cumulative impacts include those associated with the handling and dry storage of foreign research reactor spent

nuclear fuel at the Savannah River Site and the following existing or major foreseeable activities proposed for the site:

- The operation of the Vogtle Electric Generating Plant located approximately 16 km (10 mi) south west of the center of the Savannah River Site.
- The implementation of the preferred scenario in the Interim Management of Nuclear Materials EIS (DOE, 1995b).
- Shipment of aluminum-based spent nuclear fuel to the Savannah River Site for storage and disposal discussed in Appendix C of the Programmatic SNF&INEL Final EIS (DOE, 1995g).
- Completion of the construction and operation of the Defense Waste Processing Facility (DOE, 1994g).
- Processing of F-Canyon plutonium solutions to metal (DOE, 1994a).
- Treatment and minimization of radioactive and hazardous wastes at the site as identified in the Savannah River Site Waste Management Final EIS (DOE, 1995f).
- Construction of an accelerator for tritium production at the Savannah River Site, along with associated support facilities (DOE, 1995a).
- Disposition of Surplus Highly Enriched Uranium at the site (DOE, 1995e).
- Storage and Disposition of Weapons-Usable Fissile Materials.
- Stockpile Stewardship and Management Program.
- Current Savannah River Site projects (based on 1993 data).

Any other foreseeable activities would have minimal impacts compared to the activities considered above.

Table F-38 summarizes the cumulative impacts for land use, socioeconomic, nonradiological air quality, occupational and public health and safety, waste generation, and energy and water consumption. As shown in Table F-38, the contribution of foreign research reactor spent nuclear fuel to the cumulative impacts at the Savannah River Site would be minimal.

#### **F.4.1.5 Unavoidable Adverse Environmental Impacts**

The construction and operation of facilities for the receipt and management of foreign research reactor spent nuclear fuel at the Savannah River Site would result in some adverse impacts to the environment. Changes in designs and other methods of mitigation could eliminate, avoid, or reduce most impacts to minimal levels. The following paragraphs identify adverse impacts that mitigation could not reduce to minimal levels or avoid altogether.

The generation of some fugitive dust during construction would be unavoidable, but could be controlled by water and dust suppressants. Similarly, construction activities would result in some minor, yet unavoidable, noise impacts from heavy equipment, generators, and vehicles.

The maximum loss of habitat would result from conversion of approximately 4 ha (10 acres) of managed pine forest to industrial land use.

**Table F-38 Cumulative Impacts at the Savannah River Site**

<i>Environmental Impact Parameter</i>	<i>FRR SNF Contribution</i>	<i>Current Activities<sup>a</sup></i>	<i>Other Activities<sup>b</sup></i>	<i>Cumulative Impact</i>
Land Use (acres)	9	9,075 <sup>c</sup>	3,975	13,059
Socioeconomics (persons)	190 <sup>d</sup> /30 <sup>e</sup>	(f)	11,000 <sup>d</sup> /6,200 <sup>e</sup>	11,190 <sup>d</sup> /6,230 <sup>e</sup>
Air Quality (nonradiological)	See Table F-38A	See Table F-38A	See Table F-38A	See Table F-38A
<i>Occupational and Public Health and Safety:</i>				
• MEI Dose (rem/yr)	3.6x10 <sup>-7</sup>	0.00025	0.0041	0.0043
LCF (per year)	1.8x10 <sup>-10</sup>	1.25x10 <sup>-7</sup>	0.000002	0.000002
• Population Dose (person-rem/yr)	0.022	9.1	295	304
LCF (per year)	0.000011	0.0045	0.15	0.154
• Worker Collective Dose (person-rem/yr)	10 <sup>8</sup>	263	1,418	1,691
LCF (per year)	0.004	0.10	0.57	0.67
<i>Energy and Water Consumption<sup>j</sup></i>				
• Electricity (MW-hr/yr)	1,000	659,000	4,104,106 <sup>h</sup>	4,764,106
• Fuel (million l/yr)	0	28.4	3.06	31.47
• Steam (million kg/yr)	0	1,700	1,550	3,250
• Coal (tons/yr)	0	210,000	20,440	230,440
• Water (million l/yr)	2.2	88,200	6,796	94,996
<i>Waste Generation</i>				
• High-Level (m <sup>3</sup> /yr)	0	(i)	6,330	6,330
• Low-Level (m <sup>3</sup> /yr)	22	(i)	35,600	35,622
• Saltstone (m <sup>3</sup> /yr)	0	(i)	60,000	60,000
• Transuranic (m <sup>3</sup> /yr)	0	(i)	1,038	1,038
• Mixed/Hazardous (m <sup>3</sup> /yr)	0	(i)	2,561	2,561

*FRR SNF = Foreign Research Reactor Spent Nuclear Fuel*

<sup>a</sup> Based on 1993 site data

<sup>b</sup> Other activities include: interim management of nuclear materials, spent nuclear fuel management, Vogtle plant operation, defense waste processing facility operations, stabilization of Pu-solutions, site-wide waste management activities, tritium accelerator facility, disposition of surplus HEU, storage and disposition of weapons-usable fissile materials, and the stockpile stewardship and management program activities

<sup>c</sup> Five percent of the total SRS site area of 181,500 acres

<sup>d</sup> Increase over baseline during construction activities

<sup>e</sup> Increase over baseline during operation activities

<sup>f</sup> Baseline working force approximately 20,600 persons

<sup>g</sup> The dose is due to the handling of the FRR SNF during receipt and transfer between facilities averaged over 40 years

<sup>h</sup> Major portion is the requirement for electricity by the tritium production accelerator facility (3,740,000 MW-hr/yr)

<sup>i</sup> Included in "other activities"

<sup>j</sup> During operation activities

The amount of radioactivity that incident-free operation of the spent nuclear fuel facilities would release is a small fraction of the cumulative operational releases at the Savannah River Site and would be well below applicable regulatory standards (see Tables F-38 and F-38A).

**Table F-38A Estimated Maximum Nonradiological Cumulative Ground-Level Concentrations of Criteria and Toxic Pollutants at the Savannah River Site Boundary<sup>a</sup>**

<i>Pollutant</i>	<i>Averaging Time</i>	<i>Regulatory Standard, (µg/m<sup>3</sup>)</i>	<i>Cumulative Concentration (µg/m<sup>3</sup>)<sup>b</sup></i>
Carbon Monoxide	1-hour	40,000	331.7 (0.83%)
	8-hour	10,000	52.3 (0.52%)
Nitrogen Oxides	Annual	100	19.5 (19.5%)
Sulfur Dioxide	3-hour	1,300	1,159 (89.1%)
	24-hour	365	248 (68.2%)
	Annual	80	17 (21.3%)
Gaseous Fluorides	12-hour	3.7	1.38 (37.3%)
	24-hour	2.9	0.58 (20%)
	1 week	1.6	0.56 (34.8%)
	1 month	0.8	0.066 (8.2%)
Nitric Acid	24-hour	125	9.8 (7.8%)

<sup>a</sup> Concentrations represent: foreign research reactor spent nuclear fuel management, other DOE-owned spent nuclear fuel management, defense waste processing facility operations, consolidated incineration facility operation, stabilization of Pu-solutions, waste management activities, tritium supply and recycling, disposition of surplus highly enriched uranium, storage and disposition of weapons-usable fissile materials, and stockpile and stewardship management program activities

<sup>b</sup> Numbers in parentheses indicate the percentage of the regulatory standard

#### F.4.1.6 Irreversible and Irretrievable Commitments of Resources

The irreversible and irretrievable commitment of resources resulting from the construction and operation of facilities for the receipt and storage of foreign research reactor spent nuclear fuel would involve materials that could not be recovered or recycled or that would be consumed or reduced to unrecoverable forms. The construction and operation of facilities for foreign research reactor spent nuclear fuel facilities at the Savannah River Site would consume irretrievable amounts of electrical energy, fuel, concrete, sand, and gravel. Other resources used in construction would probably not be recoverable. These would include finished steel, aluminum, copper, plastics, and lumber. Most of this material would be incorporated in foundations, structures, and machinery. Construction and operation of facilities for foreign research reactor spent nuclear fuel management would also require the withdrawal of water from surface- and groundwater sources, but most of this water would return to onsite streams or the Savannah River after use and treatment.

#### F.4.1.7 Mitigation Measures

Mitigation is addressed in general terms and describes typical measures that the Savannah River Site could implement. The analyses indicate that the environmental consequences attributable to foreign research reactor spent nuclear fuel management activities at the Savannah River Site would be minimal in most environmental media.

**Pollution Prevention:** DOE is committed to comply with Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements;" Executive Order 12780, "Federal Acquisition, Recycling and Waste Prevention;" and applicable DOE orders and guidance documents in planning and implementing pollution prevention at the Savannah River Site. The pollution prevention program at the Savannah River Site was initiated in 1990 as a waste minimization program. Currently, the program consists of four major initiatives: solid waste minimization, source reduction and recycling of

wastewater discharges, source reduction of air emissions, and potential procurement of products manufactured from recycled materials. Since 1991, waste (all types) generated at the Savannah River Site has decreased, with the greatest reductions in hazardous and mixed wastes. These reductions are attributable primarily to material substitutions (DOE, 1995g).

All foreign research reactor spent nuclear fuel activities at the Savannah River Site would be subject to a pollution prevention program. Implementation of the program plan would minimize waste generated by these activities (DOE, 1995g).

*Cultural Resources:* A Programmatic Memorandum of Understanding, ratified on August 24, 1990, between the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Office, and the Advisory Council on Historic Preservation is the instrument for the management of cultural resources at the Savannah River Site. DOE uses this memorandum to identify cultural resources and develop mitigation plans for affected resources in consultation with the State Historic Preservation Office.

DOE would comply with the terms of the memorandum in support of foreign research reactor spent nuclear fuel activities at the Savannah River Site. For example, DOE would survey sites prior to disturbance and reduce impacts to any potentially significant resources discovered through avoidance or removal. Any artifacts encountered would be protected from further disturbance and the elements until removed (DOE, 1995g).

DOE conducted an investigation of Native American concerns over religious rights in the Central Savannah River Valley in conjunction with studies in 1991 related to a New Production Reactor. During this study, three Native American groups expressed concern over sites and items of religious significance on the Savannah River Site. DOE has included these organizations on its environmental mailing list, solicits their comments on NEPA actions on the Savannah River Site, and sends them documents about the Savannah River Site environmental activities, including those related to foreign research reactor spent nuclear fuel management considerations. These Native American groups would be consulted on any actions that may follow subsequent site-specific environmental reviews (DOE, 1995g).

*Geology:* DOE expects that there would be no impacts to geologic resources at the Savannah River Site under any storage option evaluated. Potential soil erosion in areas of ground disturbance would be minimized through sound engineering practices such as implementing controls for storm water runoff (e.g., sediment barriers), slope stability (e.g., rip-rap placement), and wind erosion (e.g., covering soil stockpiles). Relandscaping would minimize soil loss after construction was completed. These measures would be included in a site-specific Storm Water Pollution Prevention Plan that the Savannah River Site would prepare prior to initiating any construction (DOE, 1995g).

*Air Resources:* DOE would meet applicable standards and permit limits for all radiological and nonradiological releases to the atmosphere. In addition, the Savannah River Site would follow the DOE policy of maintaining radiological emissions to levels "as low as reasonably achievable" (ALARA). ALARA is an approach to radiation protection to control or manage exposures (both individual and collective) and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit, but rather a process that has as its objective the attainment of dose levels as far below the applicable limits as practicable (DOE, 1995g).

*Water Resources:* DOE would minimize the potential for adverse impacts on surface water during construction through the implementation of a storm water pollution prevention plan that details controls

for erosion and sedimentation. The plan would also establish measures for prevention of spills of fuel and chemicals and for rapid containment and cleanup (DOE, 1994g).

DOE could minimize water usage during both construction and operation of facilities by instituting water conservation measures such as instructing workers in water conservation (e.g., turn off hoses when not in use), installing flow restrictors, and using self-closing hose nozzles (DOE, 1995g).

*Ecological Resources:* DOE does not anticipate any impact on wetlands on the Savannah River Site as a result of the spent nuclear fuel program. In any case, it is DOE and the Savannah River Site policy to achieve “no net loss” of wetlands. Pursuant to this goal, DOE has issued a guidance document, “Information for Mitigation Impacts at the Savannah River Site,” for project planners that puts forth a practical approach to wetlands protection that begins with avoidance of impacts (if possible), moves to minimization of impacts (if avoidance is impossible), and requires compensatory measures (wetlands restoration, creation, or acquisition) in the event that impacts cannot be avoided (DOE, 1995g).

The analysis indicates that there are no threatened or endangered species or sensitive habitats in the areas considered as representative of potential sites for foreign research reactor spent nuclear fuel activities at the Savannah River Site. However, DOE would perform site-specific predevelopment surveys to ensure that development of new facilities would not impact any of these biological resources (DOE, 1995g).

*Noise:* DOE anticipates that noise impacts both on and off the Savannah River Site would be minimal. DOE does not foresee noise impacts from the management of foreign research reactor spent nuclear fuel that would warrant mitigation measures beyond those consistent with good construction, engineering, operations, and management practices.

*Traffic and Transportation:* DOE has a system of onsite buses operating at the Savannah River Site. The Savannah River Site would evaluate the need for upgrades or changes in service that might be required for foreign research reactor spent nuclear fuel management activities and would make changes, as necessary.

DOE would manage changes in traffic volume or patterns during construction through such measures as designating routes for construction vehicles, providing workers with safety reminders, and upgrading onsite police traffic patrols, if necessary.

*Occupational and Public Health and Safety:* The DOE program for maintaining radiological emissions to levels “as low as reasonably achievable” would minimize any impacts to workers and the public due to atmospheric releases. Likewise, the Site Pollution Prevention Plan and emergency preparedness measures would enhance safety both on and off the Site (DOE, 1995g).

*Accidents:* The Savannah River Site has in place emergency action plans that would be activated in the case of an accident. These plans contain both onsite provisions (e.g., evacuation plans, response teams, medical and fire response, training and drills, communications equipment) and offsite arrangements (e.g., response plans for medical and fire agencies, coordination with local and State agencies, communication plans). The Savannah River Site plans would be updated to include any new facilities or activities related to spent nuclear fuel management that would involve the Savannah River Site. The execution of the plans in response to an accident would mitigate adverse effects both on the Savannah River Site and in all the surrounding areas (DOE, 1995g).

#### **F.4.2 Idaho National Engineering Laboratory**

If the Idaho National Engineering Laboratory is the site to manage all DOE-owned spent nuclear fuel, foreign research reactor spent nuclear fuel would be received and managed at the site until ultimate

disposition. If the Idaho National Engineering Laboratory is not the site to manage DOE-owned spent nuclear fuel, foreign research reactor spent nuclear fuel could be received and managed at the Idaho National Engineering Laboratory until the selected site(s) would be ready to receive the foreign research reactor spent nuclear fuel. The construction of new facilities for managing foreign research reactor spent nuclear fuel is estimated to take about 10 years; this period is referred to as Phase 1. The period following Phase 1 until ultimate disposition is referred to as Phase 2 (approximately 30 years). The amount of spent nuclear fuel that could be received at the Idaho National Engineering Laboratory under the basic implementation of Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS. Accordingly, the Idaho National Engineering Laboratory could receive one-half of the foreign research reactor spent nuclear fuel under the Decentralization and the 1992/1993 Planning Basis alternatives, all of the TRIGA-type foreign research reactor spent nuclear fuel under the Regionalization by Fuel Type alternative, only the foreign research reactor spent nuclear fuel from Western ports under the Regionalization by Geography Alternative, or all foreign research reactor spent nuclear fuel under the Centralization Alternative. As discussed in Section 2.6.4.1, the split of foreign research reactor spent nuclear fuel evenly between the Savannah River Site and the Idaho National Engineering Laboratory under the Decentralization and 1992/1993 Planning Basis alternatives in the Programmatic SNF&INEL Final EIS was not considered to have a practical basis, and was therefore not evaluated in detail.

As a potential Phase 1 site, the Idaho National Engineering Laboratory would receive and manage foreign research reactor spent nuclear fuel at existing dry and wet storage facilities. The existing facilities identified for this purpose would be the FAST facility in CPP-666, the IFSF in CPP-603, and the CPP-749 storage area. Descriptions of these facilities are provided in Appendix F, Section F.3.

The FAST facility is a modern underwater storage facility which has been used in the past for receipt and storage of foreign research reactor spent nuclear fuel. It has the capability to receive and unload spent nuclear fuel casks at a rate of approximately five per week. Storage capacity for up to 8,400 foreign research reactor spent nuclear fuel elements could be provided in a 10-year period by using the spent nuclear fuel storage racks that would be installed. The capability of the FAST facility to receive foreign research reactor spent nuclear fuel in the near term is limited due to the number of activities scheduled through FY 1998. Considering these activities, DOE estimates that 3,600 elements could be received by the end of 1999 at the FAST facility.

The IFSF is a shielded dry storage vault originally constructed for Fort St. Vrain reactor fuel. The storage capacity available is for approximately 9,000 foreign research reactor spent nuclear fuel elements. However, as with the FAST facility, many activities are already scheduled for the facility. Considering these activities, foreign research reactor spent nuclear fuel could not be received until sometime in FY 1997 and could continue at the rate of 50 shipments per year (approximately 1,500 elements) thereafter.

The CPP-749 underground spent nuclear fuel storage area is a dry storage facility with a remote unloading area and vault storage. With some refurbishment it could provide space for 3,600 elements starting in FY 1998 and 7,000 elements after FY 2002. The spent nuclear fuel would go through the IFSF to be placed in baskets and transferred to a compatible storage cask. The refurbishments of existing facilities are part of the ongoing programs at the site to be performed independent of the proposed action in this EIS.

Between these facilities there is sufficient storage space and handling capacity to accommodate the receipt and management of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory during the Phase 1 period. The storage capacity available and estimated maximum receipt rate

of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory was shown earlier in Figure F-18.

An additional option to enhance storage capacity during Phase 1 would be to use the existing facilities to unload the transportation casks, and provide storage capacity in dry storage casks which would be placed near the existing facility.

As a Phase 2 site, the Idaho National Engineering Laboratory would continue to receive and manage foreign research reactor spent nuclear fuel at existing facilities until a new dry storage facility becomes operational at the site. Foreign research reactor spent nuclear fuel managed at existing facilities would then be transferred to the new facility where it would remain until ultimate disposition. The new facility would also receive foreign research reactor spent nuclear fuel shipments directly from ports after Phase 1 concluded. Dry storage encompasses both the dry vault design and the dry cask design as described in Section 2.6.5.1.1.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory is based on the above considerations. The analysis options selected do not represent all possible combinations, but a reasonable set which provides a typical, and in many cases, bounding estimate of the resulting impacts.

The specific analysis options under the basic implementation of Management Alternative 1 are as follows:

- 2A. The Idaho National Engineering Laboratory would receive foreign research reactor spent nuclear fuel during Phase 1 and manage it at the FAST, the IFSF, and/or the CPP-749 facilities. For the purpose of this analysis, the amount of fuel to be stored is all foreign research reactor spent nuclear fuel that would be received in a 10-year period (17,500 elements). The fuel would be shipped offsite at the end of Phase 1.
- 2B. Foreign research reactor spent nuclear fuel managed under analysis option 2A would be transferred to a newly constructed dry storage facility where it would be managed until ultimate disposition. Spent nuclear fuel arriving at the United States after Phase 1 concludes would be received and managed at the new dry storage facility until ultimate disposition. For the purpose of this analysis, the amount of spent nuclear fuel that would be stored in the dry storage facility would be all the foreign research reactor spent nuclear fuel eligible under the policy (22,700 elements).

The implementation alternatives of Management Alternative 1 for managing foreign research reactor spent nuclear fuel in the United States, as discussed in Section 2.2.2, introduce additional analysis options that could be considered for the Idaho National Engineering Laboratory as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Idaho National Engineering Laboratory would be likely to receive and manage foreign research reactor spent nuclear fuel in existing facilities during the Phase 1 period. The impacts would be bounded by analysis option 2A above. The dry storage facility considered in analysis option 2B would be sized to accommodate this amount of fuel. The spent nuclear fuel would either be shipped offsite after Phase 1, or it would be managed along with the rest of the spent nuclear fuel that would be managed at the Idaho National Engineering Laboratory.

- Under Implementation Subalternative 1b (Section 2.2.2.1), the Idaho National Engineering Laboratory would receive only HEU from the reactors eligible under the policy. The amount of HEU would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the storage of this amount of fuel at the Idaho National Engineering Laboratory would be bounded by analysis options 2A and 2B above.
- Under Implementation Subalternative 1c (Section 2.2.2.1), the Idaho National Engineering Laboratory would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which represents in uranium content approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis options 2A or 2B by a small percentage.
- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years and therefore the amount of spent nuclear fuel available for acceptance would also be decreased. The impacts from the management of the decreased amount of spent nuclear fuel at the Idaho National Engineering Laboratory would be bounded by analysis options 2A or 2B above.
- Under Implementation Subalternative 2b, (Section 2.2.2.2), the acceptance of a small portion of the spent nuclear fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in analysis options 2A or 2B.
- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be accepted by the United States because the foreign research reactors would consider their own alternatives about whether to send the spent nuclear fuel to the United States. The amount of foreign research reactor spent nuclear fuel in this case cannot be quantified. The upper limit, however, as considered under analysis options 2A or 2B, would be bounding.
- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of the foreign research reactor spent nuclear fuel would be taken. The choices do not affect the impacts at the Idaho National Engineering Laboratory.
- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Idaho National Engineering Laboratory for Phase 2 until ultimate disposition. The new wet storage facility is described in Section 2.6.5.1.2. For this implementation alternative, an analysis option 2C, which is similar to option 2B, is considered as follows:

2C. The spent nuclear fuel managed under option 2A would be transferred to a newly constructed wet storage facility where it would be managed until ultimate disposition. Spent nuclear fuel arriving in the United States after Phase 1 concludes would be received and managed at the new wet storage facility until ultimate disposition. For the purpose of this analysis, the amount of spent nuclear fuel that would be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel eligible under the policy (approximately 22,700 elements).

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. As noted in the discussion in Section 2.3.6, chemical separation of both aluminum-based and TRIGA foreign research reactor spent nuclear fuel is evaluated for the Idaho National Engineering Laboratory.

Under Management Alternative 3 (Hybrid Alternative), as discussed in Section 2.4, the Idaho National Engineering Laboratory would receive the foreign research reactor TRIGA spent nuclear fuel. This spent nuclear fuel would be managed at the Idaho National Engineering Laboratory in existing facilities until ultimate disposition. The amount of TRIGA spent nuclear fuel that would be stored is 4,900 elements, 1.0 MTHM, 19 m<sup>3</sup> (670 ft<sup>3</sup>).

#### **F.4.2.1 Existing Facilities (Phase 1)**

Analysis option 2A utilizes existing facilities for receipt and storage of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory. The impacts from this analysis option include only those related to operations, specifically: socioeconomics, occupational and public health and safety, utilities and energy, air quality, and waste management. For this analysis, it was assumed that the amount of foreign research reactor spent nuclear fuel to be received at this management site is the maximum and the receipt rate is uniform at approximately 1,800 elements per year.

##### **F.4.2.1.1 Socioeconomics**

Potential socioeconomic impacts associated with analysis option 2A would be attributable to staffing requirements at existing facilities (FAST and IFSF). Currently, these facilities are being used to store spent nuclear fuel, so any incremental staffing requirements related to foreign research reactor spent nuclear fuel storage would be insignificant. All personnel required for the operation and support of the existing facilities could be acquired from the current work force at the Idaho National Engineering Laboratory. Use of the current work force would not result in any net socioeconomic impact relative to baseline environmental conditions. In fact, using the current work force would partially compensate for the decline in employment expected from changes in site mission.

##### **F.4.2.1.2 Occupational and Public Health and Safety**

*Emission-Related Impacts:* Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory would be attributed to emissions of radioactive material that could be carried by wind offsite. The public would be too far from the locations where handling activities or storage would take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and resulting doses are discussed in Section F.6 of this appendix. Table F-39 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Idaho National Engineering Laboratory. Integrated doses for the duration of a specific period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-39 Annual Public Impacts for Foreign Research Reactor Spent Nuclear  
Fuel Receipt and Storage in Existing Facilities at the Idaho National Engineering  
Laboratory (Phase 1)**

<i>Facility</i>	<i>MEI Dose (mrem/yr)</i>	<i>MEI Risk (LCF/yr)</i>	<i>Population Dose (person-rem/yr)</i>	<i>Population Risk (LCF/yr)</i>
<i>Receipt/Unloading at:</i>				
• IFSF/PPP-749 (dry storage)	0.00056	$2.8 \times 10^{-10}$	0.0045	0.0000023
• FAST (wet storage)	0.00038	$1.9 \times 10^{-10}$	0.0031	0.0000016
<i>Storage at:</i>				
• IFSF/PPP-749 (dry storage)	0	0	0	0
• FAST (wet storage)	$3.8 \times 10^{-9}$	$1.9 \times 10^{-15}$	$3.1 \times 10^{-8}$	$1.6 \times 10^{-11}$

**Handling-Related Impacts:** Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask), transferring the spent nuclear fuel from one facility to another, or preparing the spent nuclear fuel for shipment offsite. Analysis option 2A involves the receipt of 644 shipments of foreign research reactor spent nuclear fuel into existing storage facilities (IFSF/PPP-749 and FAST) during Phase 1, and the preparation of 161 transportation casks for shipment at the end of Phase 1. It was assumed that at the end of a 10-year period, the foreign research reactor spent nuclear fuel would have decayed sufficiently to be accommodated in larger capacity transportation casks, such as those currently used in the United States for commercial spent nuclear fuel. For the purpose of the analysis, the transportation casks used for intrasite shipping are assumed to have a capacity four times as large as the capacity of the transportation casks used for the marine transport of the foreign research reactor spent nuclear fuel to the United States. Calculations were performed for both dry and wet existing storage facilities. The assumptions and methodologies used to calculate the doses to a working crew associated with the handling activities of the foreign research reactor spent nuclear fuel are described in Section F.5 of this appendix.

The collective doses that would be received by the members of the working crew and the associated risk were calculated for Phase 1 operations. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the administrative or regulatory limit at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this limit, he or she would be rotated into a different job to prevent further exposure. This regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent. The collective dose to the workers handling the transportation casks is 257 person-rem at the dry storage facilities and 250 person-rem at the wet storage facilities. The associated risk of incurring an LCF is 0.10.

#### **F.4.2.1.3 Material, Utility, and Energy Requirements**

The material, utility, and energy requirements at the FAST and IFSF are typical of those for wet storage and dry storage, respectively. They are discussed in more detail in Sections F.4.2.2.1.12 and F.4.2.2.2.12. Table F-40 summarizes the estimated annual requirements for these technologies.

**Table F-40 Annual Utility and Energy Requirements for Foreign Research Reactor  
Spent Nuclear Fuel Storage at Existing Facilities at the Idaho National Engineering  
Laboratory (Phase 1)**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>FAST</i>	<i>IFSF</i>	<i>Percent Increase</i>
Electricity (MW-hr/year)	208,000	1,490	1,490	0.72 percent
Water (l/year)	6,500,000,000	1.93 million	2.12 million	0.033 percent
Fuel (l/year)	11,123,400	0	0	0 percent

The requirements for all storage options represent a small percentage of current requirements. No new generation or treatment facilities would be necessary. Increases in the Idaho National Engineering Laboratory fuel consumption would be minimal because overall activity would not increase due to changes in the Idaho National Engineering Laboratory mission and the general reduction in employment levels. The overall impacts of any of the storage options at the Idaho National Engineering Laboratory on materials, utilities, and energy resources would be minimal.

The existing capacities and distribution systems at the Idaho National Engineering Laboratory for electricity, steam, water, and domestic wastewater treatment are adequate to support the receipt and storage of foreign research reactor spent nuclear fuel for all storage options.

Some of the electric power at the Idaho National Engineering Laboratory is generated onsite, and the remainder is provided by the Idaho Power Company. The Utah Power and Light Company Antelope Substation, which is located on the Idaho National Engineering Laboratory, connects to the Scoville Substation, from which electricity is distributed to various facilities over a 138-kilovolt loop at the Idaho National Engineering Laboratory.

All water supplies for the Idaho National Engineering Laboratory are obtained from the Snake River Plain aquifer through wells. Pumping totals approximately 7 million m<sup>3</sup> per year (1.8 billion gallons per year). ICPP has a coal-fired steam system. Natural gas is not used at the Idaho National Engineering Laboratory.

#### **F.4.2.1.4 Waste Management**

Waste production associated with the operation of the FAST and IFSF facilities is characteristic to wet and dry storage, respectively, and is discussed in detail in Sections F.4.2.2.1.13 and F.4.2.2.2.13.

#### **F.4.2.1.5 Air Quality**

*Nonradiological Emissions:* It is expected that the ambient concentration levels from incident-free operation of existing facilities would not change from baseline concentrations due to the addition of foreign research reactor spent nuclear fuel. The baseline ambient concentrations are given in Table F-41. They are all below applicable standards and guidelines.

*Radiological Emissions:* Radiological emissions from the receipt and storage of foreign research reactor spent nuclear fuel in the existing facilities at the Idaho National Engineering Laboratory are discussed in Section F.4.2.1.2.

#### **F.4.2.1.6 Water Resources**

The use of FAST and IFSF facilities for the interim storage of foreign research reactor spent nuclear fuel would not change the current levels of water and usage of these facilities. Nor would it change thermal discharges from cooling water or the quantity or quality of radioactive and nonradioactive wastewater effluents.

**Table F-41 Maximum Impacts to Nonradiological Air Quality from Spent Nuclear Fuel<sup>a,b</sup> at Existing Facilities at the Idaho National Engineering Laboratory (Phase 1)**

<i>Pollutant</i>	<i>Averaging Time</i>	<i>Applicable Standard (µg/m<sup>3</sup>)<sup>c</sup></i>	<i>Maximum Baseline Concentration (µg/m<sup>3</sup>)</i>	<i>Baseline plus Foreign Research Reactor Spent Nuclear Fuel (µg/m<sup>3</sup>)</i>	<i>Percent of Standard</i>
<i>Criteria pollutants</i>					
• Carbon Monoxide	1-hr	40,000	1,200	1,200	3.8
• Nitrogen Dioxide	Annual	100	14.1	14.1	14.1
• Lead	Quarterly	1.5	0.002	0.002	0.1
• Particulate Matter (PM <sub>10</sub> )	24-hr	150	112	112	75
	Annual	50	19	19	38
• Sulfur dioxide	3-hr	1,300	534	534	41.1
	24-hr	365	238	238	65.3
	Annual	80	4.2	4.2	5.3
<i>Other pollutants mandated by Idaho</i>					
• Total Suspended Particulates	24-hr	150	120 <sup>d</sup>	120	80
	Annual	60	45	45	75
• Fluorides	Monthly	62,168	0	0	0
	Bimonthly	46,626	0	0	0
	Annual	31,084	0	0	0
<i>Hazardous/toxic air pollutants (carcinogens)</i>					
• Ammonia Hydroxide	8-hr	180	0.33	36	20
• Benzene	Annual	12	0.029	0.029	16
• Formaldehyde	Annual	770	0.012	0.012	16
• Hexone	8-hr	2,100	0	0	0
• Hydrofluoric Acid	8-hr	25	0	0	0
• Tributylphosphate	8-hr	25	0	0	0

<sup>a</sup> Source: (DOE, 1995g).

<sup>b</sup> Listed concentrations are the maximum of those calculated at the Idaho National Engineering Laboratory site boundary, public access roads inside the Idaho National Engineering Laboratory site boundary, and the Craters of the Moon National Monument.

<sup>c</sup> To convert to µ g/ft<sup>3</sup>, multiply by 0.0283.

<sup>d</sup> The background concentration for the 24-hour standard is the same as the background for annual average concentration.

Interim storage of foreign research reactor spent nuclear fuel in existing facilities would not affect the quality of water resources because it would be stored in contained storage pools or above-grade and below-grade dry storage containers isolated from the environment.

With respect to accident conditions, the Programmatic SNF&INEL Final EIS concluded that on the basis of a bounding accident scenario for high-level waste tank failure, accidental leakage would cause negligible impacts to water resources (DOE, 1995g).

#### F.4.2.2 New Facilities (Phase 2)

Analysis options 2B and 2C involve the use of new facilities. The environmental impacts analyzed relate to the construction and operation of these new facilities. The impacts include: land use; socioeconomic; cultural resources; aesthetic and scenic resources; geology; air and water quality; ecology; noise; traffic and transportation; occupational and public health and safety; materials, utilities and energy; and waste management.

The impacts are presented in terms of storage technologies: dry storage in Sections F.4.2.2.1 and wet storage in Section F.4.2.2.2. Accident analysis, which is associated primarily with the storage technology rather than specific facilities, is presented in Section F.4.2.3.

#### **F.4.2.2.1 Dry Storage**

Analysis option 2B is associated with dry storage of foreign research reactor spent nuclear fuel in new facilities. This analysis option would require the construction of a new dry storage facility at the Idaho National Engineering Laboratory. The dry storage option encompasses both the dry vault design and the dry cask design as described in Section 2.6.5 of this EIS and earlier in this appendix. There are no environmental impact parameters that would discriminate between the two designs. For the purpose of this analysis, the impacts from the larger dry vault design are presented.

##### **F.4.2.2.1.1 Land Use**

A new dry storage facility could be located in one of several developed areas, including the ICPP. These areas, which have already been developed for industrial use, occupy about 4,560 ha (11,400 acres). Construction activities, including laydown areas, would disturb 3.7 ha (9 acres) of land. This represents about 0.06 percent of the developed space at these areas. A new dry storage facility would occupy 5,000 m<sup>2</sup> (54,000 ft<sup>2</sup>) of land and would move 11,000 m<sup>3</sup> (14,400 yd<sup>3</sup>) of soil. Neither construction nor operation of a new dry storage facility at any of the areas would significantly impact land use patterns on the Idaho National Engineering Laboratory.

##### **F.4.2.2.1.2 Socioeconomics**

As discussed in Section F.3.1.1 the total capital cost of a new dry storage facility is estimated to be \$370 million. Construction activities are projected to take 4 years. Assuming that the capital cost is evenly distributed over this 4-year period, the annual expenditures would be about \$92.5 million. This represents approximately 15.4 percent of the estimated FY 1995 total expenditures for the Idaho National Engineering Laboratory (600 million). The relative socioeconomic impact from annual construction expenditures on the region of influence would be positive. The annual operations costs of a new dry storage facility are estimated to be \$15.6 million for receipt and handling and \$0.6 million for storage. These costs represent approximately 2.6 percent and 0.1 percent of FY 1995 total expenditures for the Idaho National Engineering Laboratory. The relative socioeconomic impact from annual operation expenditures on the region of influence would be small.

Direct employment associated with construction of a new dry storage facility is estimated to be 190 persons. The relative socioeconomic impact from direct and secondary construction employment on the region of influence would be negligible. In addition, when compared to the projected FY 1995 work force at the Idaho National Engineering Laboratory of approximately 11,600 persons, the relative socioeconomic impact of this temporary increase in construction employment would be insignificant. Direct employment associated with receipt and storage operations is estimated to be 30 persons. Upon completion of these activities, direct employment is expected to decrease to 8 persons. The relative socioeconomic impact of this increase in operations employment would be insignificant to both the region of influence and the Idaho National Engineering Laboratory.

#### **F.4.2.2.1.3 Cultural Resources**

No direct impacts on any cultural resources would be expected from the construction and operation of a new dry storage facility. Surveys of previously disturbed areas at the Idaho National Engineering Laboratory found no eligible cultural resources. Native American treaty rights that would affect any future land use on the Idaho National Engineering Laboratory would not be impacted (DOE, 1995g). Because activities associated with spent nuclear fuel management would take place within existing facility areas currently engaged in similar activities, DOE does not expect any impacts to important Native American resources from alteration of the visual setting or noise associated with the construction or operation of any new facilities. DOE has developed plans to be in full compliance with cultural resource laws (DOE, 1995g).

#### **F.4.2.2.1.4 Aesthetic and Scenic Resources**

Construction and operation of a new dry storage facility would not adversely impact aesthetic or scenic resources. A new dry storage facility would not be visible from any onsite or offsite public access roads. Potential soil erosion and dust generation associated with construction-related activities would be controlled by the implementation of best-management practices. Any visibility impacts from fugitive dust generation by construction-related activities should be insignificant and short term. Facility operations associated with the dry storage of foreign research reactor spent nuclear fuel should not generate any atmospheric emissions which would reduce area visibility (DOE, 1995g).

#### **F.4.2.2.1.5 Geology**

There are no unique geologic features or minerals of economic value on the Idaho National Engineering Laboratory that would be adversely impacted by site development. Construction of a new dry storage facility would result in localized impacts to surficial soils, and would necessitate the clearing and grading of 3.7 ha (9 acres). Site preparation, land shaping, and grading activities associated with construction would present a slight to moderate erosion hazard, but would be controlled and minimized by implementing best-management practices. The operation of the new dry storage facility would have no effect on the geologic characteristics at the site.

#### **F.4.2.2.1.6 Air Quality**

*Nonradiological Emissions:* Potential impacts from construction activities at the Idaho National Engineering Laboratory would include fugitive dust from construction activities (e.g., clearing of land, grading, road preparation) and vehicle emissions from the heavy equipment utilized during the construction phase of the project. Construction of a new dry fuel storage facility would be located near the center of the Idaho National Engineering Laboratory. The construction of this facility would require disturbance of approximately 3.7 ha (9 acres) of land. However, the overall construction impacts to the ambient air quality of the region should be minimal due to the short duration (3 months to 6 years). As outlined in Table F-42, the ambient air quality impacts associated with construction-related activities would be minimal and the Idaho National Engineering Laboratory compliance with Federal and State ambient air quality standards would not be adversely affected. Therefore, construction activities would not be expected to have any detrimental effect on the health and safety of the general population.

**Table F-42 Estimated Maximum Concentrations of Criteria Pollutants at the Idaho National Engineering Laboratory Attributable to New Dry Storage Construction**

<i>Pollutant</i>	<i>Averaging Time</i>	<i>Ambient Standard<sup>a</sup></i>	<i>Baseline Concentration</i>	<i>Construction Activities</i>
<i>Idaho National Engineering Laboratory Boundary (µg/m<sup>3</sup>)<sup>b</sup></i>				
• Particulate Matter (PM <sub>10</sub> )	24-hr	150	112	0.0274
	Annual	50	19	0.0014
• Carbon Monoxide	1-hr	40,000	1,200	2.42
	8-hr	10,000	340	0.97
• Sulfur Dioxide	3-hr	1,300	534	0.397
	24-hr	365	238	0.085
	Annual	80	4.2	0.004
• Nitrogen Dioxide	Annual	100	14.1	0.068
<i>Public Roads Boundary (µg/m<sup>3</sup>)</i>				
• Particulate Matter (PM <sub>10</sub> )	24-hr	150	112	0.0050
	Annual	50	19	0.0006
• Carbon Monoxide	1-hr	40,000	1,200	6.69
	8-hr	10,000	340	1.28
• Sulfur Dioxide	3-hr	1,300	534	0.727
	24-hr	365	238	0.117
• Nitrogen Dioxide	Annual	100	14.1	0.211
<i>Craters of the Moon Boundary (µg/m<sup>3</sup>)</i>				
• Particulate Matter (PM <sub>10</sub> )	24-hr	150	112	0.00037
	Annual	50	19	0.00003
• Carbon Monoxide	1-hr	40,000	1,200	0.61
	8-hr	10,000	340	0.08
• Sulfur Dioxide	3-hr	1,300	534	0.054
	24-hr	365	238	0.009
	Annual	80	4.2	0.0006
• Nitrogen Dioxide	Annual	100	14.1	0.009

<sup>a</sup> Source: DOE, 1995g.

<sup>b</sup> To convert to µg/ft<sup>3</sup>, multiply by 0.0283.

No nonradiological air emissions would be expected during operation of a new dry storage facility. Any emissions would be directly attributable to front-end wet storage activities only.

**Radiological Emissions:** No radiological emissions would be produced during construction of a new dry storage facility.

Based on fuel drying and storage operations conducted at the Idaho National Engineering Laboratory, potential atmospheric releases from the spent nuclear fuel storage facility would consist of minor amounts of particulate radioactive material and larger amounts of gaseous fission products that could escape from the fuel through cladding defects. The majority of radioactive material responsible for fuel and cask internal surface contamination consists of activation products that plate out on the spent nuclear fuel assemblies during reactor operation. This material is dependent on corrosion of structural materials and generally consists of radionuclides, such as <sup>58</sup>Co, <sup>60</sup>Co, <sup>59</sup>Fe, etc. This contamination activity would have to be controlled during the cask opening and fuel handling operations to prevent internal personnel exposures. Proper facility ventilation (designed to provide airflow from areas of low contamination to progressively higher contamination) would help provide contamination control. High-efficiency

particulate air filters in the facility exhaust would reduce the airborne effluent quantities of this particulate material to quantities that are well within the prescribed limits.

Cask opening and fuel drying operations may also be responsible for the release of significant amounts of  $^3\text{H}$ ,  $^{85}\text{Kr}$ , and minor amounts of  $^{129}\text{I}$ . The amounts of these radionuclides released during the cask opening operation depends on the following parameters: (1) the number of spent nuclear fuel clad defects, (2) the spent nuclear fuel material and the diffusion rate of these radionuclides through the fuel matrix for the fuel temperature while in the cask, and (3) the time that the spent nuclear fuel is contained within the cask before opening.

Similarly, for fuel drying operations, the temperature of the drying gas (as well as the parameters discussed above) would cause quantities of  $^3\text{H}$ ,  $^{85}\text{Kr}$ , and  $^{129}\text{I}$  to be released from the fuel. Charcoal or silver zeolite filters could be used to remove the  $^{129}\text{I}$  from the exhaust, but the  $^3\text{H}$  and  $^{85}\text{Kr}$ , being gases, or in a gaseous state for the case of tritiated water, would be exhausted to the atmosphere. During spent nuclear fuel storage, small amounts of the gaseous/volatile radionuclides are expected to be released to the environment based on the fuel matrix, clad defects, and storage temperature. Release rates would decrease with storage time due to radioactive decay. It is anticipated that the fuel drying operation would be responsible for the most significant release of these gaseous/volatile radionuclides to the environment.

For this analysis, radiological emissions from the operation of a new dry storage facility for foreign research reactor spent nuclear fuel were calculated based on the methodology and assumptions described in Section F.6. The radiological consequences of air emissions from dry storage operation at the Idaho National Engineering Laboratory are discussed in Section F.4.2.2.1.11. The annual emission releases from the dry storage facility during receipt and unloading and storage are provided in Section F.6.6.1.

#### **F.4.2.2.1.7 Water Resources**

The water usage during construction of a new dry storage facility is estimated to be about 7.75 million l (2 million gal). During operations, annual water consumption would be 2.1 million l (550,000 gal) for receipt and handling and 0.4 million l (109,000 gal) for storage. With an annual average water usage of approximately 6,500 million l (1,717 million gal) for the Idaho National Engineering Laboratory, these amounts represent approximately a 0.03 percent increase in annual water usage. Therefore, a new dry storage facility would have minimal impact on water resources at the Idaho National Engineering Laboratory.

Best-management practices during construction would prevent sediment runoff or spills of fuels or chemicals. Therefore, construction activities should have no impact on water quality at the Idaho National Engineering Laboratory. The impact on water quality during operations would also be negligible. Existing water treatment facilities at the Idaho National Engineering Laboratory could accommodate any new domestic and process wastewater streams from a new dry storage facility. The expected total flow volumes at the Idaho National Engineering Laboratory would still be well within the design capacities of treatment systems at the Idaho National Engineering Laboratory. A new dry storage facility would meet National Pollutant Discharge Elimination System limits and reporting requirements, so no impact on the water quality of receiving streams is expected.

#### F.4.2.2.1.8 Ecology

*Terrestrial Resources:* DOE expects that construction impacts, which would include the loss of some wildlife habitat due to land clearing and facility development, would be greatest under the Regionalization and Centralization Alternatives under the Programmatic SNF&INEL Final EIS at the Idaho National Engineering Laboratory. Construction impacts from foreign research reactor spent nuclear fuel storage would not be significant because the construction activity would take place either within the boundaries of heavily developed areas or adjacent to those areas. However, construction activities could provide opportunities for the spread of exotic plant species, such as cheatgrass and Russian thistle (DOE, 1995g).

*Wetlands:* There would be no construction impacts to wetlands, which would be excluded from development, and impacts to threatened and endangered species would be unlikely given the location of previously-developed areas and the maximum size of the affected area of 3.7 ha (9 acres). Construction activities at the Idaho National Engineering Laboratory probably would not affect either of the endangered species found onsite (e.g., bald eagle and peregrine falcon). Both of these birds of prey are associated with riparian areas, wetlands, and larger bodies of water (e.g., reservoirs) and inhabit dry upland areas only temporarily when migrating. Disturbance to other sensitive (but not Federally-listed) species (e.g., the burrowing owl, northern goshawk, ferruginous hawk, Swainson's hawk, gyrfalcon, Townsend's western big-eared bat, and pygmy rabbit) would be possible but unlikely given the scale of the planned construction. Any impacts would be negligible and would last only as long as construction activities continue (DOE, 1995g).

*Threatened and Endangered Species:* Representative impacts from operations would include the disturbance and displacement of animals (such as the pronghorn antelope) caused by the movement and noise of personnel, equipment, and vehicles. Such impacts would be greatest under the Regionalization by Fuel Type and Geography, and Centralization Alternatives under the Programmatic SNF&INEL Final EIS at the Idaho National Engineering Laboratory, which would involve a generally higher level of operational activity; however, these impacts would be minor (DOE, 1995g). DOE has completed consultations with the U.S. Fish and Wildlife Service regarding threatened and endangered species for the potential construction site of foreign research reactor spent nuclear fuel storage facilities at the Idaho National Engineering Laboratory, as required by the Endangered Species Act. Letters regarding consultation under the Endangered Species Act are included in Volume 2, Appendix B of the Programmatic SNF&INEL Final EIS (DOE, 1995g).

#### F.4.2.2.1.9 Noise

Noise generated onsite by construction or operation of a new dry storage facility should not adversely affect the public or the Idaho National Engineering Laboratory environment. Noise generated by construction would be site-specific and short lived. A limited number of new construction jobs would be generated, but the resulting temporary increase in worker and truck traffic is expected to be insignificant within the context of existing site traffic loads. Noise generated by operation would not significantly impact the environment because the facility would be located adjacent to previously developed, industrialized areas. Rail shipments of foreign research reactor spent nuclear fuel would be a small fraction of the rail traffic on the Blackfoot-to-Arco Branch of the Union Pacific System line that crosses the Idaho National Engineering Laboratory. There may be a slight increase in truck traffic to and from the potential storage site, but it is not expected to result in a perceptible increase in traffic noise or any change in community reaction to noise along the major access routes to the Idaho National Engineering Laboratory (DOE, 1995g).

#### F.4.2.2.1.10 Traffic and Transportation

Construction materials, wastes, and excavated materials would be transported both onsite and offsite. These activities would result in increases in operation of personal-use vehicles by commuting construction workers, commercial truck traffic, and in traffic associated with the daily operations of the Idaho National Engineering Laboratory. Again, traffic congestion would not be a significant problem.

Traffic due to operations of a new dry storage facility would not increase site levels because the required workers would be drawn from the existing Idaho National Engineering Laboratory labor force.

#### F.4.2.2.1.11 Occupational and Public Health and Safety

*Emissions-Related Impacts:* Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory would be attributed to emissions of radioactive material that could be carried by the wind offsite. The general public would be too far from the locations where handling or storage take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and resulting doses are discussed in Section F.5 of this appendix. Table F-43 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Idaho National Engineering Laboratory. Integrated doses for the duration of a specific period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-43 Annual Public Impacts for Foreign Research Reactor Spent Nuclear  
Fuel Receipt and Storage at the Idaho National Engineering Laboratory  
(New Dry Storage)**

<i>Facility</i>	<i>MEI Dose (mrem/yr)</i>	<i>MEI Risk (LCF/yr)</i>	<i>Population Dose (person-rem/yr)</i>	<i>Population Risk (LCF/yr)</i>
Receipt/Unloading at: • New Dry Storage Facility <sup>a</sup>	0.00056	$2.8 \times 10^{-10}$	0.0045	0.0000023
Storage at: • New Dry Storage Facility	0	0	0	0

<sup>a</sup> The doses for this new dry storage facility are assumed to be equal to those for IFSF/PPP-749.

*Handling-Related Impacts:* Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask), transferring the spent nuclear fuel from one facility to another, or preparing the spent nuclear fuel for shipment offsite. Analysis option 2B involves the receipt of 644 shipments of foreign research reactor spent nuclear fuel into the existing dry and wet storage facilities (IFSFP/PPP-749 and FAST) during Phase 1, the preparation of 161 transportation casks for shipment to a dry storage facility at the end of Phase 1, and the receipt of 193 shipments of foreign research reactor spent nuclear fuel at the new dry storage facility after Phase 1 operations. It was assumed that at the end of a 10-year period, the foreign research reactor spent nuclear fuel would have decayed sufficiently to be accommodated in larger capacity transportation casks, such as those currently used in the United States for commercial spent nuclear fuel. For the purpose of this analysis, the transportation casks used for intrasite shipping are assumed to have a capacity four times as large as the capacity of the

transportation casks used for the marine transport of the foreign research reactor spent nuclear fuel to the United States. Collective doses were calculated for both dry storage designs, the vault and the dry cask. The assumptions and methodology used to calculate the doses are described in Section F.5 of this appendix.

Table F-44 presents the doses that would be received by the members of the working crew and the associated risk if that working crew handled the total number of transportation casks at the Idaho National Engineering Laboratory. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the administrative or regulatory limit at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this limit, he or she would be rotated into a different job to prevent further exposure. This regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent.

**Table F-44 Handling-Related Impacts to Workers at the Idaho National Engineering Laboratory (New Dry Storage)**

	<i>Worker Population Dose (person-rem)</i>		<i>Worker Population Risk (LCF)</i>	
	<i>New Dry Storage Cask</i>	<i>New Dry Storage Vault</i>	<i>New Dry Storage Cask</i>	<i>New Dry Storage Vault</i>
Phases 1 and 2 <sup>a</sup>	424	370	0.17	0.15
Phases 1 and 2 <sup>b</sup>	416	363	0.17	0.15

<sup>a</sup> Phase 1 at IFSF/CP-749

<sup>b</sup> Phase 1 at FAST

#### F.4.2.2.1.12 Material, Utility, and Energy Requirements

Construction of a new dry storage facility at the Idaho National Engineering Laboratory would consume 21,800 m<sup>3</sup> (28,500 yd<sup>3</sup>) of concrete and 5,200 metric tons (5,750 tons) of steel. The total energy and water requirements during construction are estimated to be 835,000 l (221,000 gal) for fuel, and 7.75 million l (2 million gal) for water. The annual utility and energy requirements during operations are shown in Table F-45. These requirements represent a small percent of current requirements for the Idaho National Engineering Laboratory. No new generation or treatment facilities would be necessary, and connections to existing networks would require only short tie-in lines. Increases in consumption would be minimal because overall activity on the Idaho National Engineering Laboratory is expected to decrease because of changes in site mission and a general reduction in employment.

**Table F-45 Annual Utility and Energy Requirements for New Dry Storage at the Idaho National Engineering Laboratory**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>Dry Storage Usage</i>	<i>Percent Increase</i>
Electricity (MW-hr/yr)	208,000	800 - 1,000	0.48 percent
Fuel (l/yr)	11,123,400	0	0 percent
Water (l/yr)	6,500,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.025 percent <sup>a</sup> 0.006 percent <sup>b</sup>

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

#### F.4.2.2.1.13 Waste Management

Construction of a new dry storage facility at the Idaho National Engineering Laboratory would generate 1,800 m<sup>3</sup> (2,400 yd<sup>3</sup>) of debris. The annual quantities of waste generated during operations are shown in Table F-46. These quantities represent a very small percent increase above current levels at the Idaho National Engineering Laboratory. Existing waste management storage and disposal activities at the Idaho National Engineering Laboratory could accommodate the waste generated by a new dry storage facility. Therefore, the impact of this waste on existing Idaho National Engineering Laboratory waste management capacities would be minimal.

**Table F-46 Annual Waste Generated for New Dry Storage at the Idaho National Engineering Laboratory**

<i>Waste Form</i>	<i>Baseline Site Generation</i>	<i>Dry Storage Generation</i>	<i>Percent Increase</i>
High-Level (m <sup>3</sup> /yr)	750	none	0 percent
Transuranic (m <sup>3</sup> /yr)	712	none	0 percent
Solid Low-Level (m <sup>3</sup> /yr)	4,795	22 <sup>a</sup> 1 <sup>b</sup>	0.5 percent <sup>a</sup> 0.02 percent <sup>b</sup>
Wastewater (l/yr)	540,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.29 percent <sup>a</sup> 0.074 percent <sup>b</sup>

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

#### F.4.2.2.2 Wet Storage

Analysis option 2C involves long-term wet storage of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory. This analysis option would require the construction of a new wet storage facility at the site (Implementation Alternative 5 of Management Alternative 1).

##### F.4.2.2.2.1 Land Use

A new wet storage facility could be located in one of several developed areas, including the ICPP. These areas, which have already been developed for industrial use, occupy about 4,560 ha (11,400 acres). Construction activities, including laydown areas, would disturb 2.8 ha (7 acres) of land. This represents about 0.06 percent of the developed space at these areas. A new wet storage facility would occupy 3,800 m<sup>2</sup> (41,000 ft<sup>2</sup>) of land and would move 18,000 m<sup>3</sup> (24,000 yd<sup>3</sup>) of soil. Neither construction nor operation of a new wet storage facility at any of the areas would significantly impact land use patterns on the Idaho National Engineering Laboratory.

##### F.4.2.2.2.2 Socioeconomics

As discussed in Section F.3.2 the total capital cost of a new wet storage facility is estimated to be \$449 million. Construction activities are projected to take 4 years. Assuming that the capital cost is evenly distributed over this 4-year period, the annual expenditures would be about \$112.2 million. This represents approximately 18.7 percent of the estimated FY 1995 total expenditures for the Idaho National Engineering Laboratory (600 million). The relative socioeconomic impact from annual construction expenditures on the region of influence would be positive. The annual operations costs of a new wet storage facility are estimated to be \$23.3 million for receipt and handling and \$3.5 million for storage.

These costs represent about 3.8 percent and 0.6 percent of FY 1995 total expenditures for the Idaho National Engineering Laboratory. The relative socioeconomic impact from annual operation expenditures on the region of influence would be small.

Direct employment associated with construction of a new wet storage facility is estimated to be 157 persons. The relative socioeconomic impact from direct construction employment on the region of influence would be small. In addition, when compared to the projected FY 1995 work force at the Idaho National Engineering Laboratory of approximately 11,600 persons, the relative socioeconomic impact of this temporary increase in construction employment would be insignificant. Direct employment associated with operations of a new wet storage facility is estimated to be 30 persons. The relative socioeconomic impact of this increase in operations employment would be small to both the region of influence and the Idaho National Engineering Laboratory.

#### **F.4.2.2.2.3 Cultural Resources**

Impacts to cultural resources would be the same as for new dry storage (Section F.4.2.2.1.3).

#### **F.4.2.2.2.4 Aesthetic and Scenic Resources**

Impacts to aesthetic and scenic resources would be the same as for new dry storage (Section F.4.2.2.1.4).

#### **F.4.2.2.2.5 Geology**

Impacts to geology would be the same as for new dry storage (Section F.4.2.2.1.5).

#### **F.4.2.2.2.6 Air Quality**

*Nonradiological Emissions:* Construction of a new wet storage facility would necessitate the clearing and grading of approximately 3 ha (7 acres) of land. In comparison, approximately 4 ha (10 acres) of land would be disturbed by new dry storage construction. Therefore, air quality impacts associated with wet storage construction would be bound by those associated with dry storage construction, as presented in Section F.4.2.2.1.6.

No nonradiological emissions from the operation of the new wet storage facility are expected.

*Radiological Emissions:* Incident-free airborne releases from the new wet storage facility would be limited to radioactive noble gases and some radioactive iodine which could be released from the stored fuel prior to canning. The airborne materials released to the building atmosphere during incident-free operations would be filtered by the building heating and ventilation system. Radioactive and nonradioactive effluent gases would be routed through double-banked high-efficiency particulate air filters prior to release to the environment through an exhaust air system. The high-efficiency particulate air filter would have a minimum efficiency of 99.97 percent for 0.3-micron diameter particulates and would allow in-place dioctyl phthalate testing.

The new wet storage facility would discharge all ventilated gas, except truck exhaust, to the facility's exhaust system. Truck exhaust would be discharged directly to the environment during cask off-loading operations in the truck receiving area. The exhaust air system would employ a detector to monitor <sup>137</sup>Cs.

For other building areas which would be sources of airborne radioactive contamination, the heating, ventilation, and air conditioning system would be designed to maintain airflow from areas of low potential contamination into areas of higher potential contamination. These airborne effluents would be required to be below the radioactivity concentration guides listed in DOE Order 5480.1B for both onsite and offsite concentrations (DOE, 1989b).

Air emissions from the new wet storage facility are expected to be similar to the air emissions from the IFSF at the Idaho National Engineering Laboratory. The annual air emission level for the IFSF was designed to result in ground-level concentrations of less than 0.003 percent of DOE Order 5480.1B limits for uncontrolled areas.

Radiological emissions from the operation of the new wet storage facility were calculated based on the methodology and assumptions used in Appendix F, Section F.6. The annual emission releases from the wet storage facility during the receipt and unloading, and storage are provided in Section F.6.6.1.

No radiological emissions would be produced during construction of a new wet storage facility.

#### **F.4.2.2.2.7 Water Resources**

The annual water usage during construction and operation of a new wet storage facility is estimated to be about 1.9 million l (502,000 gal) and 2.7 million l (0.72 million gal), respectively. With an annual average water usage of approximately 6,500 million l (1,717 million gal) for the Idaho National Engineering Laboratory, these amounts represent an increase of about 0.03 percent and less than 0.04 percent, respectively. Therefore, a new wet storage facility would have minimal impact on water resources at the Idaho National Engineering Laboratory.

Best-management practices during construction would prevent sediment runoff or spills of fuels or chemicals. Therefore, construction activities should have no impact on water quality at the Idaho National Engineering Laboratory. The impact on water quality during operations would also be negligible. Existing water treatment facilities at the Idaho National Engineering Laboratory could accommodate any new domestic and process wastewater streams from a new wet storage facility. The expected total flow volumes at the Idaho National Engineering Laboratory would still be well within the design capacities of treatment systems at the Idaho National Engineering Laboratory. A new wet storage facility would meet National Pollutant Discharge Elimination System limits and reporting requirements, so no impact on the water quality of receiving streams is expected.

#### **F.4.2.2.2.8 Ecology**

Impacts to ecology would be the same as for new dry storage (Section F.4.2.2.1.8).

#### **F.4.2.2.2.9 Noise**

Impacts from noise would be the same as for new dry storage (Section F.4.2.2.1.9).

#### **F.4.2.2.2.10 Traffic and Transportation**

Impacts from traffic and transportation would be the same as for new dry storage (Section F.4.2.2.1.10).

#### F.4.2.2.2.11 Occupational and Public Health and Safety

**Emission-Related Impacts:** Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory would be attributed to emissions of radioactive material that could be carried by wind offsite. The public would be too far from the locations where handling activities and storage take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and resulting doses are discussed in Section F.6 of this appendix. Table F-47 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Idaho National Engineering Laboratory for wet storage. Integrated doses for the duration of a specific implementation period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-47 Annual Public Impacts for Receipt and Storage of Foreign Research Reactor Spent Nuclear Fuel at the Idaho National Engineering Laboratory (Implementation Alternative 5 of Management Alternative 1)**

Facility	MEI Dose (mrem/yr)	Risk (LCF/yr)	Population Dose (person-rem/yr)	Population Risk (LCF/yr)
Receipt/Unloading at • New Wet Storage Facility	0.00038	$1.9 \times 10^{-10}$	0.0031	0.0000016
Storage at: • New Wet Storage Facility	$3.8 \times 10^{-9}$	$1.9 \times 10^{-15}$	$3.1 \times 10^{-8}$	$1.6 \times 10^{-11}$

**Handling-Related Impacts:** Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask), transferring the foreign research reactor spent nuclear fuel from one facility to another, or preparing the foreign research reactor spent nuclear fuel for shipment offsite. Analysis option 2C involves the receipt of 644 shipments of foreign research reactor spent nuclear fuel into the existing facilities (IFSF/CP-749 and FAST) during Phase 1, the preparation of 161 transportation casks for shipment to a wet storage facility at the end of Phase 1, and the receipt of 193 shipments directly from the ports into the new wet storage facility after Phase 1 operations. It was assumed that at the end of a 10-year period, the foreign research reactor spent nuclear fuel would have decayed sufficiently to be accommodated in larger capacity transportation casks, such as those currently used in the United States for commercial spent nuclear fuel. For the purpose of this analysis, the transportation casks used for intrasite shipping are assumed to have a capacity four times as large as the capacity of the transportation casks used for the marine transport of the foreign research reactor spent nuclear fuel to the United States. The assumptions and methodologies used to calculate the doses to a working crew associated with the handling activities of the foreign research reactor spent nuclear fuel are described in Section F.5 of this appendix.

Table F-48 presents the population dose that would be received by the members of the working crew and the associated risk if that working crew handled the total number of transportation casks at the Idaho National Engineering Laboratory. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the administrative limits at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this limit, he or she would be rotated into a different job to prevent further exposure. This

regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent.

**Table F-48 Handling-Related Impacts to Workers at the Idaho National Engineering Laboratory (Implementation Alternative 5 of Management Alternative 1)**

<i>Facility</i>	<i>Worker Population Dose (person-rem)</i>	<i>Worker Population Risk (LCF)</i>
Phase 1: IFSF/CPP-749	257	0.10
Phase 1 and Phase 2	367	0.15
Phase 1: FAST	250	0.10
Phase 1 and Phase 2	360	0.14

#### **F.4.2.2.2.12 Material, Utility, and Energy Requirements**

Construction of a new wet storage facility at the Idaho National Engineering Laboratory would consume 12,400 m<sup>3</sup> (16,260 yd<sup>3</sup>) of concrete and 3,100 metric tons (3,443 tons) of steel. The total energy and water requirements during construction are estimated to be 600,000 l (159,000 gal) for fuel, and 4.4 million l (1.2 million gal) for water. The annual utility and energy requirements during operations are shown in Table F-49. These requirements represent a small percent of current requirements for the Idaho National Engineering Laboratory. No new generation or treatment facilities would be necessary, and connections to existing networks would require only short tie-in lines. Increases in consumption would be minimal because overall activity at the Idaho National Engineering Laboratory is expected to decrease because of changes in site mission and a general reduction in employment.

**Table F-49 Annual Utility and Energy Requirements for New Wet Storage at the Idaho National Engineering Laboratory (Implementation Alternative 5 to Management Alternative 1)**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>Wet Storage Usage</i>	<i>Percent Increase</i>
Electricity (MW-hr/yr)	208,000	1,000 - 1,500	0.72 percent
Fuel (l/yr)	11,123,400	0	0 percent
Water (l/yr)	6,500,000,000	2,700,000 <sup>a</sup> 1,500,000 <sup>b</sup>	0.04 percent 0.02 percent

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

#### **F.4.2.2.2.13 Waste Management**

Construction of a new wet storage facility at the Idaho National Engineering Laboratory would generate 2,600 m<sup>3</sup> (10,300 yd<sup>3</sup>) of debris. The annual quantities of waste generated during operations are shown in Table F-50. These quantities represent a very small percentage increase above current levels at the Idaho National Engineering Laboratory. Existing waste management storage and disposal activities at the Idaho National Engineering Laboratory could accommodate the waste generated by a new wet storage facility. Therefore, the impact of this waste on existing Idaho National Engineering Laboratory waste management capacities would be minimal.

**Table F-50 Annual Waste Generated for New Wet Storage at the Idaho National Engineering Laboratory (Implementation Alternative 5 to Management Alternative 1)**

<i>Waste Form</i>	<i>Baseline Site Generation</i>	<i>Wet Storage Generation</i>	<i>Percent Increase</i>
High-Level (m <sup>3</sup> /yr)	750	none	0 percent
Transuranic (m <sup>3</sup> /yr)	712	none	0 percent
Solid Low-Level (m <sup>3</sup> /yr)	4,795	16 <sup>a</sup> 1 <sup>b</sup>	0.33 percent 0.02 percent
Wastewater (l/yr)	540,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.3 percent 0.07 percent

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

### F.4.2.3 Accident Analysis

An evaluation of incident-free operations and hypothetical accidents at the Idaho National Engineering Laboratory is presented here based on the methodology presented in Appendix F, Section F.6. The evaluation assessed the possible radiation exposure to individuals and general population due to the release of radioactive materials. The analyses are based on the same operations carried out at the different potential storage locations and the same accidents at any of the sites evaluated. Information concerning radiation doses to individuals and the general population are the same as set forth in Section F.4.1.3.

Table F-51 presents frequency and consequences in terms of mrem or person-rem, of postulated accidents to the offsite MEI, NPAI, and offsite population for the 95th-percentile meteorological conditions using the assumptions and input values discussed above. The worker doses are calculated only for the 50th-percentile meteorology. This is an individual assumed to be 100 m (330 ft) downwind of the accident. DOE did not estimate the worker population dose.

**Table F-51 Frequency and Consequences of Accidents at the Idaho National Engineering Laboratory**

	Frequency (per year)	Consequences			
		MEI (mrem)	NPAI (mrem)	Population (person-rem)	Worker (mrem)
Dry Storage Accidents <sup>a</sup>					
• Spent Nuclear Fuel Assembly Breach	0.16	1.3	0.67	15	28
• Dropped Fuel Cask	0.0001	0.074	0.0033	0.83	0.12
• Aircraft Crash w\Fire	1 x 10 <sup>-6</sup>	180	2.9	2,000	120
Wet Storage Accidents <sup>b</sup>					
• Spent Nuclear Fuel Assembly Breach	0.16	0.0016	0.0036	0.43	0.14
• Accidental Criticality	0.0031	28	30	140	1800
• Aircraft Crash	1 x 10 <sup>-6</sup>	22	9.8	250	400

<sup>a</sup> IFSF/CP-749 or New Dry Storage Facility

<sup>b</sup> New Wet Storage and FAST facility

Multiplying the frequency of each accident times its consequences and converting the radiation doses to LCF yields the annual risks associated with each potential accident at the Idaho National Engineering Laboratory. These annual risks are multiplied by the maximum duration of this implementation alternative to obtain conservative estimates of risks at the Idaho National Engineering Laboratory presented in Table F-52.

**Table F-52 Annual Risks of Accidents at Idaho National Engineering Laboratory**

	<i>Risks</i>			
	<i>MEI (LCF/yr)</i>	<i>NPAI (LCF/yr)</i>	<i>Population (LCF/yr)</i>	<i>Worker (LCF/yr)</i>
<i>Dry Storage Accidents<sup>a</sup></i>				
• Spent Nuclear Fuel Assembly Breach	$1.1 \times 10^{-7}$	$5.5 \times 10^{-8}$	0.0012	0.0000018
• Dropped Fuel Cask	$3.7 \times 10^{-12}$	$1.7 \times 10^{-13}$	$4.2 \times 10^{-8}$	$4.8 \times 10^{-12}$
• Aircraft Crash w/Fire	$9.0 \times 10^{-11}$	$1.5 \times 10^{-12}$	0.0000010	$4.8 \times 10^{-11}$
<i>Wet Storage Accidents<sup>b</sup></i>				
• Spent Nuclear Fuel Assembly Breach	$1.3 \times 10^{-10}$	$2.9 \times 10^{-10}$	0.000035	$8.8 \times 10^{-9}$
• Accidental Criticality	$4.4 \times 10^{-8}$	$4.7 \times 10^{-8}$	0.00022	0.0000022
• Aircraft Crash	$1.1 \times 10^{-11}$	$4.9 \times 10^{-12}$	$1.3 \times 10^{-7}$	$1.6 \times 10^{-10}$

<sup>a</sup> IFSF/CP-749 or New Dry Storage Facility

<sup>b</sup> New Wet Storage and FAST Facility

Table F-53 presents the frequency and consequences of the accidents analyzed for Idaho National Engineering Laboratory for new wet storage (Implementation Alternative 5 of Management Alternative 1). Multiplying the frequency of each accident times its consequences and converting the radiation doses to LCF yields the annual risks associated with each potential accident at the Idaho National Engineering Laboratory. These annual risks are multiplied by the maximum duration of implementation alternative at each site to obtain conservative estimates of risks at the Idaho National Engineering Laboratory. Table F-54 presents the risk estimates from this implementation alternative.

**Table F-53 Frequency and Consequences of Accidents at the Idaho National Engineering Laboratory (Implementation Alternative 5 of Management Alternative 1)**

	Frequency (per year)	Consequences			
		MEI (mrem)	NPAI (mrem)	Population (person-rem)	Worker (mrem)
Wet Storage Accidents <sup>a</sup>					
• Spent Nuclear Fuel Assembly Breach	0.16	0.0016	0.0036	0.43	0.14
• Accidental Criticality	0.0031	28	30	140	1800
• Aircraft Crash	1 x 10 <sup>-6</sup>	22	9.8	250	400

<sup>a</sup> New Wet Storage Facility

**Table F-54 Annual Risks of Accidents at the Idaho National Engineering Laboratory (Implementation Alternative 5 of Management Alternative 1)**

	<i>Risks</i>			
	<i>MEI (LCF/yr)</i>	<i>NPAI (LCF/yr)</i>	<i>Population (LCF/yr)</i>	<i>Worker (LCF/yr)</i>
<i>Wet Storage Accidents<sup>a</sup></i>				
• Spent Nuclear Fuel Assembly Breach	$1.3 \times 10^{-10}$	$2.9 \times 10^{-10}$	0.000035	$8.8 \times 10^{-9}$
• Accidental Criticality	$4.4 \times 10^{-8}$	$4.7 \times 10^{-8}$	0.00022	0.0000022
• Aircraft Crash	$1.1 \times 10^{-11}$	$4.9 \times 10^{-12}$	$1.3 \times 10^{-7}$	$1.6 \times 10^{-10}$

<sup>a</sup> New Wet Storage Facility

#### **F.4.2.3.1 Secondary Impact of Radiological Accidents at the Idaho National Engineering Laboratory**

In the event of an accidental release of radioactivity, there is a potential for impacts to land uses, cultural resources, water quality, ecology, national defense, and local economies (secondary impacts). For this analysis, secondary impacts of radiological accidents involving foreign research reactor spent nuclear fuel have been qualitatively assessed based on the calculations presented in Section F.4.2.3. Radiological accidents that resulted in doses to the MEI of less than the annual Federal radiological exposure limit for the public of 100 mrem (10 CFR Part 20) were considered to have no secondary impacts.

The MEI dose provides a measure of the air concentration and radionuclide deposition at the receptor location. As such, it can be used to express the level of contamination from a given radiological accident. In estimating the human health effects from radiological exposure (as presented in Section F.4.1.3), the MEI dose evaluates four pathways: (1) air immersion, (2) ground surface, (3) inhalation, and (4) ingestion. In estimating the environmental effects from radiological exposure, however, only the air immersion and ground surface pathways need be considered.

At the Idaho National Engineering Laboratory, the radiological accident with the highest MEI dose is the aircraft crash into a dry storage facility with fire (Table F-51). For this accident, the MEI dose would be 180 mrem. For the air immersion and ground surface pathways only, the dose would be 3.1 mrem, which is less than the 100 mrem limit used in this analysis. Therefore, no secondary impacts to land uses, cultural resources, water quality, ecology, national defense, and local economies from radiological accidents involving foreign research reactor spent nuclear fuel storage are expected at the Idaho National Engineering Laboratory.

#### **F.4.2.4 Cumulative Impacts at the Idaho National Engineering Laboratory**

This section presents the cumulative impacts of the proposed action, potential impacts of other major contemplated DOE actions and current activities at the Idaho National Engineering Laboratory. The contemplated DOE actions are the proposed construction and operation of an accelerator facility for tritium production (along with associated support facilities) (DOE, 1995d), the management of DOE-owned spent nuclear fuel discussed in Appendix B of the Programmatic SNF&INEL Final EIS (DOE, 1995g), and the storage and disposition of weapons-usable fissile materials at the Idaho National Engineering Laboratory site.

Tables F-55 and F-55A summarize the cumulative impacts for land use, socioeconomic, nonradiological air quality, occupational and public health and safety, energy and water consumption, and waste generation. As shown in the tables, the contribution of foreign research reactor spent nuclear fuel management to the cumulative impacts at the Idaho National Engineering Laboratory would be minimal.

#### **F.4.2.5 Unavoidable Adverse Environmental Impacts**

The construction and operation of facilities for the receipt and storage of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory would result in some adverse impacts to the environment. Changes in designs and other methods of mitigation could eliminate, avoid, or reduce most of these to minimal levels. The following paragraphs identify adverse impacts that mitigation could not reduce to minimal levels or avoid altogether.

The generation of some fugitive dust during construction would be unavoidable, but would be controlled by water and dust suppressants. Similarly, construction activities would result in some minor, yet unavoidable, noise impacts from heavy equipment, generators, and vehicles.

**Table F-55 Cumulative Impacts at the Idaho National Engineering Laboratory**

<i>Environmental Impact Parameter</i>	<i>FRR SNF Contribution</i>	<i>Current Activities<sup>a</sup></i>	<i>Other Activities<sup>b</sup></i>	<i>Cumulative Impact</i>
Land Use (acres)	9	11,400 <sup>b</sup>	604	12,013 <sup>b</sup>
Socioeconomics (persons)	190 <sup>c</sup> /30 <sup>d</sup>	(e)	1980 <sup>c</sup> /1080 <sup>d</sup>	2,170 <sup>c</sup> /1,110 <sup>d</sup>
Air Quality (nonradiological)	See Table F-55A	See Table F-55A	See Table F-55A	See Table F-55A
<i>Occupational and Public Health and Safety</i>				
• MEI Dose (rem/yr)	5.6x10 <sup>-7</sup>	0.000056	0.0000057	0.000062
LCF (per year)	2.8x10 <sup>-10</sup>	2.8x10 <sup>-8</sup>	2.8x10 <sup>-9</sup>	3.1x10 <sup>-8</sup>
• Population Dose (person-rem/yr)	0.0045	0.34	32	32.3
LCF (per year)	2.25x10 <sup>-6</sup>	0.00017	0.016	0.016
• Worker Collective dose (person-rem/yr)	10 <sup>f</sup>	30	344	384
LCF (per year)	0.004	0.012	0.137	0.154
<i>Energy and Water Consumption</i>				
• Electricity (MW-hr/yr)	1,000	208,000	3,897,000 <sup>g</sup>	4,106,000
• Fuel (million l/yr)	0	11.1	1.35	12.45
• Coal (tons/yr)	0	12,500	13,660	26,160
• Water (million l/yr)	2.2	6,500	1,314	7,816
<i>Waste Generation</i>				
• High-Level (m <sup>3</sup> /yr)	0	750	160	910
• Low-Level (m <sup>3</sup> /yr)	22	4,795	2,800	7,617
• Transuranic (m <sup>3</sup> /yr)	0	712	46	758
• Mixed (m <sup>3</sup> /yr)	0	243	8	251

*FRR SNF = Foreign Research Reactor Spent Nuclear Fuel*

<sup>a</sup> Other activities include: DOE-owned spent nuclear fuel management, construction and operation of a tritium accelerator facility, and the disposition of weapons-usable fissile materials

<sup>b</sup> Two percent of the total Idaho National Engineering Laboratory site area of 570,000 acres

<sup>c</sup> Increase over baseline during construction activities

<sup>d</sup> Increase over baseline during operation activities

<sup>e</sup> Baseline working force is approximately 11,600 persons

<sup>f</sup> The dose is due to the handling of FRR SNF during receipt and transfer, averaged over 40 years

<sup>g</sup> Major portion is the requirement for electricity by the tritium production accelerator facility (3,740,000 MW-hr/yr)

The maximum loss of habitat would involve the conversion of approximately 4 ha (10 acres) of previously disturbed habitat that is of low quality and limited use to wildlife.

The amount of radioactivity that incident-free operation of the spent nuclear fuel facilities would release is a small fraction of the cumulative operational releases at the Idaho National Engineering Laboratory and would be well below applicable regulatory standards.

#### **F.4.2.6 Irreversible and Irretrievable Commitments of Resources**

The irreversible and irretrievable commitment of resources resulting from the construction and operation of facilities for the receipt and storage of foreign research reactor spent nuclear fuel would involve materials that could not be recovered or recycled or that would be consumed or reduced to unrecoverable forms. The construction and operation of facilities for foreign research reactor spent nuclear fuel facilities at the Idaho National Engineering Laboratory would consume irretrievable amounts of electrical energy,

**Table F-55A Estimated Maximum Nonradiological Cumulative Ground-Level Concentrations of Criteria and Toxic Pollutants at the Idaho National Engineering Laboratory Boundary<sup>a</sup>**

<i>Pollutant</i>	<i>Averaging Time</i>	<i>Regulatory Standard (µg/m<sup>3</sup>)</i>	<i>Cumulative Concentration (µg/m<sup>3</sup>)<sup>b</sup></i>
Carbon Monoxide	1-hour	40,000	1,245 (3.1%)
	8-hour	10,000	354 (3.5%)
Nitrogen Oxides	Annual	100	15 (15%)
Sulfur Dioxide	3-hour	1,300	660 (51%)
	24-hour	365	267 (73%)
	Annual	80	7.5 (9.3%)
Particulate Matter (PM <sub>10</sub> )	24-hour	150	82 (55%)
	Annual	50	5 (10%)

<sup>a</sup> Concentrations represent: foreign research reactor spent nuclear fuel management, other DOE-owned spent fuel management, construction and operation of a tritium supply facility and recycling activities, storage and disposition of weapons-usable fissile material activities, and current activities

<sup>b</sup> Numbers in parentheses indicate the percentage of the regulatory standard

fuel, concrete, sand, and gravel. Other resources used in construction would probably not be recoverable. These would include finished steel, aluminum, copper, plastics, and lumber. Most of this material would be incorporated in foundations, structures, and machinery.

#### **F.4.2.7 Mitigation Measures**

Mitigation is addressed in general terms and describes typical measures that the Idaho National Engineering Laboratory could implement. The analyses indicate that the environmental consequences attributable to foreign research reactor spent nuclear fuel management activities at the Idaho National Engineering Laboratory would be minimal in most environmental media.

*Pollution Prevention:* DOE is committed to comply with Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements;" Executive Order 12873, "Federal Acquisition, Recycling and Waste Prevention;" and applicable DOE orders and guidance documents in planning and implementing pollution prevention at the Idaho National Engineering Laboratory. The DOE views source reduction as the first priority in its pollution prevention program, followed by an increased emphasis on recycling. Waste treatment and disposal are considered only when prevention or recycling is not possible or practical (DOE, 1995g).

*Cultural Resources:* The lack of detailed specifications associated with the potential construction at the Idaho National Engineering Laboratory under the various storage options prevents the identification of specific project impacts and mitigation measures for particular structures and facilities. Basic compliance under cultural resource law involves five steps that would be essentially the same under all alternatives. These steps are: (a) identification and evaluation of resources in danger of impact, (b) assessment of effects to these resources in consultation with the State Historic Preservation Office and representatives of the Shoshone-Bannock Tribes, (c) development of plans and documents to minimize any adverse effects, (d) consultation with the Advisory Council on Historic Preservation and Tribal representatives as to the appropriateness of mitigation measures, and (e) implementation of mitigation measures. Therefore, if a cultural resource survey has not been performed in an area planned for ground disturbance under one of the storage options, consultation would be initiated with the Idaho State Historic Preservation Office, and

the survey would be conducted prior to any disturbance. If cultural resources were discovered, they would be evaluated according to National Register criteria. Wherever possible, important resources would be left undisturbed. If the impacts are determined to be adverse and it is not feasible to leave the resource undisturbed, then measures would be initiated to reduce impacts. All mitigation plans would be developed in consultation with the State Historic Preservation Office and the Advisory Council on Historic Preservation and would conform to appropriate standards and guidelines established for historic preservation activities by the Secretary of the Interior (DOE, 1995g).

Some actions may affect areas of religious, cultural, or historic value to Native Americans. DOE has implemented a Working Agreement to ensure communication with the Shoshone-Bannock Tribes, especially relating to the treatment of archaeological sites during excavation, as mandated by the Archaeological Resources Protection Act; the protection of human remains, as required under the Native American Graves Protection and Repatriation Act; and the free exercise of religion as protected by the American Indian Religious Freedom Act. In keeping with DOE Native American policy, DOE Order 1230.2, and procedures to be defined in the Final Cultural Resources Management Plan, DOE would conduct Native American consultation during the planning and implementation of the policy. Procedures for dealing with the inadvertent discovery of human remains would be consistent with the Native American Graves Protection and Repatriation Act. If human remains were discovered, DOE would notify all Tribes that have expressed an interest in the repatriation of graves as required under Native American Graves Protection and Repatriation Act, including the Shoshone-Bannock, Shoshone, Paiute, and the Northwestern band of the Shoshone Nation. These Tribes would then have an opportunity to claim the remains and associated artifacts in accordance with the requirements of Native American Graves Protection and Repatriation Act (DOE, 1995g).

*Traffic and Transportation:* All onsite shipments of foreign research reactor spent nuclear fuel would be in compliance with ID Directive 5480.3, "Hazardous Materials Packaging and Transportation Safety Requirements." These requirements provide assurance that, under normal conditions, the Idaho National Engineering Laboratory would meet "as low as reasonably achievable" conditions, credible accident situations (those with probability of occurrence greater than  $1 \times 10^{-7}$  per year) would not result in a loss of shielding or containment or a criticality, and an unintentional release of radioactive material would generate a timely response (DOE, 1995g).

*Accidents:* The DOE would implement the Idaho National Engineering Laboratory emergency response programs, as appropriate, following the occurrence of an accident to prevent or mitigate consequences. These emergency response programs, implemented in accordance with 5500-DOE series orders, typically involve emergency planning, emergency preparedness, and emergency response actions. Participating government agencies with plans that are interrelated with the Idaho National Engineering Laboratory Emergency Plan for Action include: the State of Idaho, Bingham County, Bonneville County, Butte County, Clark County, Jefferson County, the Bureau of Indian Affairs, and Fort Hall Indian Reservation. When an emergency condition exists at a facility, the Emergency Action Director is responsible for recognition, classification, notification, and protective action recommendations. Each emergency response plan utilizes resources specifically dedicated to assist a facility in emergency management. These resources include, but are not limited, to the following (DOE, 1994h):

- Idaho National Engineering Laboratory Warning Communications Center,
- Idaho National Engineering Laboratory Fire Department,
- Facility Emergency Command Centers,

- DOE Emergency Operations Centers,
- County and State Emergency Command Centers,
- medical, health physics, and industrial hygiene specialists,
- protective clothing and equipment (respirators, breathing air supplies, etc.), and
- periodic training exercises and drills within and between the organizations involved in implementing the response plans.

### F.4.3 Hanford Site

If the Hanford Site is the site to manage DOE-owned spent nuclear fuel under the Programmatic SNF&INEL Final EIS, foreign research reactor spent nuclear fuel would be received and managed first at the Savannah River Site and/or the Idaho National Engineering Laboratory for the period required for the Hanford Site to construct and to place in operation new facilities to accommodate the spent nuclear fuel. As discussed in previous sections, this period (Phase 1) is estimated to be about 10 years. At the end of Phase 1 (e.g., start of Phase 2) the Hanford Site would be able to receive and manage foreign research reactor spent nuclear fuel that would be shipped from the Savannah River Site and/or the Idaho National Engineering Laboratory, and directly from the ports for those shipments made after Phase 1 concludes. Management of the foreign research reactor spent nuclear fuel would continue at the Hanford Site until ultimate disposition.

The amount of spent nuclear fuel that would be received and managed at the Hanford Site under Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS. Accordingly in Phase 2, the Hanford Site could receive TRIGA foreign research reactor spent nuclear fuel managed at the Idaho National Engineering Laboratory during Phase 1, Western foreign research reactor spent nuclear fuel under the Regionalization by Geography Alternative, or all foreign research reactor spent nuclear fuel under the Centralization Alternative. As a Phase 2 site, the Hanford Site would receive and manage foreign research reactor spent nuclear fuel at a new dry storage facility constructed on the 200 Area Plateau or the FMEF, which is a partially completed, large, hot cell facility. The new dry storage facility is described in Section 2.6.5.1.1. Description of the FMEF is provided in Appendix F, Section F.3.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Hanford Site is based on the above considerations. The analysis options selected do not represent all possible combinations, but a reasonable set that provides a typical, and in some cases, bounding estimate of the resulting impacts.

The specific analysis options are as follows:

- 3A. The spent nuclear fuel that was managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Hanford Site where it would be managed at a new dry storage facility constructed either at the 200 Area Plateau or at the FMEF. Spent nuclear fuel arriving in the United States after Phase 1 concludes would also be received and managed at the new facility until ultimate disposition. For the purposes of this analysis, the total amount of spent nuclear fuel that would be managed in the dry storage facility would be all the foreign research reactor spent nuclear fuel eligible under the policy (22,700 elements). If the Hanford Site receives TRIGA spent nuclear fuel from the Idaho National Engineering Laboratory or only Western spent nuclear fuel, the dry

storage facility would be sized accordingly. The impacts from a smaller size facility would be bounded by the option analyzed.

The implementation alternatives of Management Alternative 1 for managing foreign research reactor spent nuclear fuel in the United States, discussed in Section 2.2.2, introduce additional analysis options that could be considered for the Hanford Site as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Hanford Site would receive the foreign research reactor spent nuclear fuel from the Idaho National Engineering Laboratory and/or the Savannah River Site and manage it in facilities sized accordingly. The impacts from the management of this lesser amount of spent nuclear fuel would be bounded by analysis option 3A (above).
- Under Implementation Subalternative 1b (Section 2.2.2.1), the Hanford Site would receive only HEU from the Idaho National Engineering Laboratory and/or the Savannah River Site. The amount would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel at the Hanford Site would be bounded by analysis option 3A (above).
- Under Implementation Subalternative 1c (Section 2.2.2.1), the Hanford Site would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which represents in uranium content approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis option 3A by a small percentage.
- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years, and therefore the amount of spent nuclear fuel available for acceptance would also be decreased. In this case, the Hanford Site would receive all foreign research reactor spent nuclear fuel from the Savannah River Site and/or the Idaho National Engineering Laboratory. The impacts from the management of the decreased amount of spent nuclear fuel at the Hanford Site would be bounded by analysis option 3A (above).
- Under Implementation Subalternative 2b, (Section 2.2.2.2), the acceptance of a small portion of the fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and stored would remain constant. The impacts would be the same as in option 3A (above).
- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be accepted by the United States as the foreign research reactor operators would consider their own alternatives on whether to send the spent nuclear fuel to the United States. The amount of spent nuclear fuel in this case cannot be quantified; however, the upper limit, as considered under analysis option 3A, would be bounding.
- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of the foreign research reactor spent

nuclear fuel would be taken. The choices do not affect the management impacts at the Hanford Site.

- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Hanford Site for Phase 2 until ultimate disposition. For this implementation alternative, an analysis option 3B, which is similar to 3A, is considered as follows:

3B. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Hanford Site where it would be managed at a new wet storage facility constructed at either the 200 Area Plateau or the WNP-4 Spray Pond facility. Spent nuclear fuel arriving in the United States after Phase 1 concludes would also be received and managed at the new facility until ultimate disposition. For the purposes of this analysis, the total amount of spent nuclear fuel to be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel eligible under the policy (approximately 22,700 elements). If the Hanford Site receives only TRIGA spent nuclear fuel from the Idaho National Engineering Laboratory, or only western fuel, the dry storage facility would be sized accordingly. The impacts from a smaller size facility would be bounded by the option analyzed.

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. Based on the discussion in Section 2.3.6, the Hanford Site would not be considered as a site for chemical separation.

Under Management Alternative 3 (Hybrid Alternative) the Hanford Site is not considered.

#### **F.4.3.1 Existing Facilities**

Existing facilities at the Hanford Site include the FMEF and the WNP-4 Spray Cooling Pond for dry and wet storage, respectively, of foreign research reactor spent nuclear fuel. For this analysis, existing facilities at the Hanford Site were considered essentially as new because of the significant modifications that would be required to use them for foreign research reactor spent nuclear fuel storage. Handling and transfer operations at the FMEF and the WNP-4 Spray Cooling Pond would be used to support new dry and wet storage facilities, respectively. The evaluation of potential environmental impacts is presented in Section F.4.3.2 and reflects the foreign research reactor spent nuclear fuel storage options described in Section F.4.3.

#### **F.4.3.2 New Facilities (Phase 2)**

Analysis options 3A and 3B involve the use of new or major additions to existing facilities as discussed above. The environmental impacts analyzed relate to the construction and operation of these facilities. The impacts include: land use; socioeconomics; cultural resources; aesthetic and scenic resources; geology; air and water quality; ecology; noise; traffic and transportation; occupational and public health and safety; materials, utilities, and energy; and waste management.

##### **F.4.3.2.1 Dry Storage**

Dry storage is associated with analysis option 3A, which would require the construction of a new dry storage facility near the 200 Area Plateau or at the FMEF (FMEF currently has handling and transfer, but

not adequate storage capabilities). The dry storage option encompasses both the dry vault design and the dry cask design as described in Section 2.6.5 and Appendix F, Section F.3. There are no environmental impact parameters that would discriminate between the two designs. For the purpose of this analysis the impacts from the larger dry vault design are presented.

#### **F.4.3.2.1.1 Land Use**

A new dry storage facility would be located in either the 200 Area Plateau or at the FMEF in the 400 Area. These areas have been generally developed for industrial use. Construction activities, including laydown areas, would disturb 3.7 ha (9 acres) of land at either area. A new dry storage facility would occupy 5,000 m<sup>2</sup> (54,000 ft<sup>2</sup>) of land and would move 11,000 m<sup>3</sup> (14,400 yd<sup>3</sup>) of soil. Neither construction nor operation of a new dry storage facility at either area would significantly impact land use patterns on the Hanford Site.

#### **F.4.3.2.1.2 Socioeconomics**

As discussed in Section F.3.1.1 the total capital cost of a new dry storage facility is estimated to be \$370 million. Construction activities are projected to take 4 years. Assuming that the capital cost is evenly distributed over this 4-year period, the annual expenditures would be about \$92.5 million. This represents approximately 7.2 percent of the estimated FY 1995 total expenditures for the Hanford Site (1,288 million). The relative socioeconomic impact from annual construction expenditures on the region of influence would be positive. The annual operations costs of a new dry storage facility are estimated to be \$15.6 million for receipt and handling and \$0.6 million for storage. These costs represent approximately 1.2 percent and 0.05 percent of FY 1995 total expenditures for the Hanford Site. The relative socioeconomic impact from annual operation expenditures on the region of influence would be small.

Direct employment associated with construction of a new dry storage facility is estimated to be 190 persons. The relative socioeconomic impact from direct and secondary construction employment on the region of influence would be small. In addition, when compared to the projected FY 1995 work force at the Hanford Site of approximately 18,500 persons, the relative socioeconomic impact of this temporary increase in construction employment would be insignificant. Direct employment associated with receipt and storage operations is estimated to be 30 persons. Upon completion of these activities, direct employment is expected to decrease to eight persons. The relative socioeconomic impact of this increase in operations employment would be insignificant to both the region of influence and the Hanford Site.

#### **F.4.3.2.1.3 Cultural Resources**

No direct impacts on any cultural resources in the 200 Area Plateau would be expected from construction or operation of the new dry storage facility. This site has been surveyed for cultural resources, and no prehistoric or historic archaeological properties were found. No indirect impacts would be anticipated because no known archaeological sites are present within approximately 4 km (2.5 mi) of the 200 Area Plateau. Because the site is in an industrialized area, construction would not alter the historic significance or association with the Manhattan Project and/or Cold War facilities located nearby.

No direct or indirect impacts are expected to any cultural resources of significance to the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, or the Wanapum Band. This is based

on the location of the 200 Area Plateau relative to sacred and culturally important areas which have been identified through ethno-historical research and interviews with elders of bands that formerly used the Hanford Site (DOE, 1995g).

Modification of FMEF for dry storage would be inside the fence of the 400 Area. No cultural resources are known to exist within that area. Because of its location, no cultural resources on the Hanford Site would be disturbed by construction.

#### **F.4.3.2.1.4 Aesthetic and Scenic Resources**

Any changes caused by construction and operation of either dry storage facility would be consistent with the existing overall visual environment of the Hanford Site. Topographic features would obstruct both candidate storage sites from the view of populated areas. Although the new dry storage facility could be seen from the farmland bluffs that overlook the Columbia River to the east, these lands are on private property that is not readily accessible to the public. Potential soil erosion and dust generation associated with construction-related activities would be controlled by the implementation of best-management practices. Any visibility impacts from fugitive dust generation by construction-related activities should be insignificant and short term. Facility operations associated with the dry storage of foreign research reactor spent nuclear fuel should not generate any atmospheric emissions which would reduce area visibility (DOE, 1995g).

#### **F.4.3.2.1.5 Geology**

There are no unique geologic features or minerals of economic value on the Hanford Site that would be adversely impacted by site development. Construction of a new dry storage facility would result in localized impacts to surficial soils and would necessitate the clearing and grading of 3.7 ha (9 acres). Site preparation, land shaping, and grading activities associated with construction would present a slight to moderate erosion hazard, but would be controlled and minimized by implementing best-management practices. The operation of the new dry storage facility would have no effect on the geologic characteristics at the site.

#### **F.4.3.2.1.6 Air Quality**

*Nonradiological Emissions:* Potential air quality impacts associated with construction include generation of fugitive dust (particulate matter) and smoke from earth moving and clearing operations and emissions from construction equipment. Sources of fugitive dust include:

- transfer of soil to and from haul trucks and storage piles;
- turbulence created by construction vehicles moving over cleared, unpaved surfaces; and
- wind-induced erosion of exposed surfaces.

Emissions of sulfur dioxide and nitrogen dioxide would result entirely from diesel exhaust. For this analysis, all vehicular emissions were conservatively assumed to occur within 1 year during 200 ten-hour work days. As shown in Table F-56, air quality impacts associated with construction-related activities would be minimal, and compliance with Federal and State ambient air quality standards would not be

adversely affected. Therefore, construction activities would not be expected to have any detrimental effect on the health and safety of the general population.

**Table F-56 Estimated Maximum Concentrations of Criteria Pollutants at the Hanford Site Attributable to New Dry Storage Construction**

<i>Pollutant</i>	<i>Averaging Time</i>	<i>Ambient Standard<sup>a</sup></i>	<i>Baseline Concentration<sup>a</sup></i>	<i>Construction Activities</i>
<b>Hanford Site Boundary (<math>\mu\text{g}/\text{m}^3</math>)</b>				
• Total Suspended Particulate (TSP)	Annual	75	56	0.4
• Particulate Matter ( $\text{PM}_{10}$ )	24-hr	150	81	14
• Particulate Matter ( $\text{PM}_{10}$ )	Annual	50	27	0.4
<b>Workplace (ppmv)</b>				
• Sulfur Dioxide	Annual	52	0.5	0.4
• Nitrogen Dioxide	Annual	100	6,500	200

<sup>a</sup> Source: DOE, 1995g

Nonradiological emissions would not be expected during operation of a new dry storage facility for foreign research reactor spent nuclear fuel.

**Radiological Emissions:** No radiological emissions from construction of a new dry storage facility for foreign research reactor spent nuclear fuel would be expected. Based on fuel drying and storage operations conducted at the Idaho National Engineering Laboratory, potential atmospheric releases from the spent nuclear fuel storage facility would consist of minor amounts of particulate radioactive material and larger amounts of gaseous fission products that could escape from the fuel through cladding defects. The majority of radioactive material responsible for fuel and cask internal surface contamination consists of activation products that plate out on the spent nuclear fuel assemblies during reactor operation. This material is dependent on corrosion of structural materials and generally consists of radionuclides, such as  $^{58}\text{Co}$ ,  $^{60}\text{Co}$ ,  $^{59}\text{Fe}$ , etc. This contamination activity would have to be controlled during the cask opening and fuel handling operations to prevent internal personnel exposures. Proper facility ventilation (designed to provide airflow from areas of low contamination to progressively higher contamination) would help provide contamination control. High-efficiency particulate air filters in the facility exhaust would reduce the airborne effluent quantities of this particulate material to quantities that are well within the prescribed limits.

Cask opening and fuel drying operations may also be responsible for the release of significant amounts of  $^3\text{H}$ ,  $^{85}\text{Kr}$ , and minor amounts of  $^{129}\text{I}$ . The amounts of these radionuclides that are released during the cask opening operation depends on the following parameters: (1) the number of spent nuclear fuel clad defects; (2) the spent nuclear fuel material and the diffusion rate of these radionuclides through the fuel matrix for the fuel temperature while in the cask; and (3) the time that the spent nuclear fuel is contained within the cask before opening.

Similarly, for fuel drying operations, the temperature of the drying gas (as well as the parameters discussed above) would cause quantities of  $^3\text{H}$ ,  $^{85}\text{Kr}$ , and  $^{129}\text{I}$  to be released from the fuel. Charcoal or silver zeolite filters could be used to remove the  $^{129}\text{I}$  from the exhaust, but the  $^3\text{H}$  and  $^{85}\text{Kr}$ , being gases, or in a gaseous state for the case of tritiated water, would be exhausted to the atmosphere. During spent nuclear fuel storage small amounts of the gaseous/volatile radionuclides are expected to be released to the environment based on the fuel matrix, clad defects, and storage temperature. Release rates would decrease with storage time due to radioactive decay. It is anticipated that the fuel drying operation would be responsible for the most significant release of these gaseous/volatile radionuclides to the environment.

For this analysis, radiological emissions from the operation of a new dry storage facility for foreign research reactor spent nuclear fuel were calculated based on the methodology and assumptions described in Appendix F, Section F.6. The radiological consequences of air emissions from the operation of a new dry storage facility at the Hanford Site are discussed in Section F.4.3.2.1.11. The annual emission releases from the dry storage facility during receipt and unloading and storage are provided in Section F.6.6.

#### **F.4.3.2.1.7 Water Resources**

The water usage during construction of a new dry storage facility is estimated to be about 7.75 million l (2 million gal). During operations, annual water consumption would be 2.1 million l (550,000 gal) for receipt and handling and 0.4 million l (109,000 gal) for storage. With an annual average water usage of approximately 15,000 million l (3,960 million gal) for the Hanford Site, these amounts represent no more than a 0.04 percent increase in annual water usage. Therefore, a new dry storage facility would have minimal impact on water resources at the Hanford Site.

Best-management practices during construction would prevent sediment runoff or spills of fuels or chemicals. Therefore, construction activities should have no impact on water quality at the Hanford Site. The impact on water quality during operations would also be small. Existing water treatment facilities at the Hanford Site could accommodate any new domestic and process wastewater streams from a new dry storage facility. The expected total flow volumes at the Hanford Site would still be well within the design capacities of treatment systems at the Hanford Site. A new dry storage facility would meet National Pollutant Discharge Elimination System limits and reporting requirements, so no impact on the water quality of receiving streams is expected.

#### **F.4.3.2.1.8 Ecology**

*Terrestrial Resources:* Vegetation within construction areas would be destroyed during land-clearing activities. Plant species that are dominant on the 200 Area Plateau include: big sagebrush, cheatgrass, and Sanberg's bluegrass. Total area destroyed would amount to about less than one percent of this community on the Hanford Site. Although the plant communities to be disturbed are well-represented on Hanford Site, they are relatively uncommon regionally because of the widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants. Mitigation of these impacts would include minimizing the area of disturbance and revegetating with native species, including shrubs, and establishing a 3:1 acreage replacement habitat in concert with a habitat enhancement plan presently being developed for Hanford Site in general. Adverse impacts to vegetation on Hanford Site would be limited to the project area and vicinity, and would not affect the viability of any plant populations on the Hanford Site (Bergsman et al., 1994).

Construction of the new dry storage facility would have some adverse affect on animal populations. Less mobile animals, such as invertebrates, reptiles, and small animals within the project area would be destroyed during land-clearing activities. Larger mammals and birds in construction and adjacent areas would be disturbed by construction activities and would move to adjacent suitable habitat, and these individual animals might not survive and reproduce. Project facilities would displace about 3.7 ha (9 acres) of animal habitat for the life of the dry storage facility. Revegetated areas (e.g., construction laydown areas and buried pipeline routes) would be reinvaded by animal species from surrounding undisturbed habitats. The adverse impacts of construction are expected to be limited to the project area and vicinity and should not affect the viability of populations on the Hanford Site.

Very small quantities of radionuclides would be released to the atmosphere during dry storage facility operations. No organisms studied to date are reported to be more sensitive than man to radiation. Therefore, the effects of these releases on terrestrial organisms are expected to be minor (Bergsman et al., 1994).

Any impacts to the vegetation and animal communities would be mitigated by minimizing the amount of land disturbed during construction, employing soil erosion control measures during construction activities, and revegetating disturbed areas with native species. These mitigation measures would limit the amount of direct and indirect disturbance to the construction area and surrounding habitats and would speed the recovery process for disturbed lands (Bergsman et al., 1994).

Operational impacts on terrestrial biotic resources would include exposure of plants and animals to small amounts of radionuclides released during operation of the new dry storage facility. The levels of radionuclide exposure would be below those levels that produce adverse effects (Bergsman et al., 1994).

*Wetlands:* There are no wetlands on or near either candidate storage site (Bergsman et al., 1994).

*Threatened and Endangered Species:* Construction and operation of the new dry storage facility would remove 3.7 ha (9 acres) of relatively pristine big sagebrush/cheatgrass/Sanberg's bluegrass habitat. This sagebrush habitat is considered priority habitat by the State of Washington because of its relative scarcity in the State and its use as nesting/breeding habitat by loggerhead shrikes, sage sparrows, sage thrashers, burrowing owls, pygmy rabbits, and sagebrush voles (Bergsman et al., 1994).

Loggerhead shrikes, listed as a Federal candidate (Category 2) and State candidate species, forage on the proposed spent nuclear fuel site and are relatively common on the Hanford Site. This species is sagebrush-dependent, as it is known to select primarily tall big sagebrush as nest sites. Construction of the new dry storage facility would remove big sagebrush habitat which would preclude loggerhead shrikes from nesting there. Foreign research reactor spent nuclear fuel site development would also be expected to reduce the value of the site as foraging habitat for shrikes known to nest in adjacent areas (Bergsman et al., 1994).

Sage sparrows and sage thrashers, both State candidate species, occur in mature sagebrush/bunchgrass habitat at the Hanford Site. The sage sparrow was observed on the proposed site in a survey during spring 1994. These species are known to nest primarily in sagebrush. Construction of the new dry storage facility would preclude both of these species nesting there and reduce the site's suitability as foraging habitat for these species (Bergsman et al., 1994).

Dry storage facility construction is not expected to substantially decrease Hanford Site population of loggerhead shrikes, sage sparrows, or sage thrashers because similar sagebrush habitat is still relatively common on the Hanford Site. However, the cumulative effects of constructing the new dry storage facility, in addition to future developments that further reduce sagebrush habitat (causing further fragmentation of nesting habitat), could negatively affect the long-term viability of populations of these species on the Hanford Site (Bergsman et al., 1994).

Burrowing owls, a State candidate species, are relatively common on Hanford Site and nest in abandoned ground squirrel burrows on the 200 Area Plateau. Construction would remove sagebrush and disturb soil, displacing ground squirrels and thus reducing the suitability of the area for nesting by burrowing owls, and would also displace small mammals, which constitute a portion of the prey base for this species. Dry storage facility construction would not be expected to negatively impact the viability of the population of burrowing owls on the Hanford Site, as their use of ground squirrel burrows as nests is not limited to burrows in big sagebrush habitat (Bergsman et al., 1994).

Pygmy rabbits, a Federal candidate (Category 2) and State-listed threatened species, are known to utilize tall clumps of big sagebrush habitat throughout most of their range. However, this species has not recently been observed on the Hanford Site. Construction of the new dry storage facility would therefore reduce the potential for this species' occurrence by removing habitat suitable for its use (Bergsman et al., 1994).

Sagebrush voles, a State minor species, are common on Hanford Site and select burrow sites near sagebrush; however, this species is common only at higher elevations around the Hanford Site. Construction of the new dry storage facility would remove sagebrush habitat, precluding sagebrush voles from utilizing the site. However, construction would not affect the overall viability of sagebrush vole populations on Hanford Site because the majority of the population is found on the Fitzner/Eberhardt Arid Lands Ecology Preserve (Bergsman et al., 1994).

The closest known nests of ferruginous hawks, a Federal candidate (Category 2) and State threatened species, and Swainson's hawk, a State candidate, are 8.5 km (5 mi) and 6.2 km (3.7 mi), respectively, from the 200 Area Plateau. The potential site comprises a portion of the foraging range of these hawks. Construction of the new dry storage facility is not expected to disrupt the nesting activities of these species. However, construction would displace small mammal populations and thus reduce the prey for these birds. The cumulative effects of constructing the new dry storage facility, in addition to future reductions in sagebrush habitat (causing further fragmentation of foraging habitat), could negatively affect the long-term viability of populations of these two species on the Hanford Site (Bergsman et al., 1994).

Piper's daisy, listed as a State sensitive species, is relatively uncommon but widely distributed across the Hanford Site. Piper's daisy occurs in gravelly soils on the 200 Area Plateau. If construction of the new dry storage facility includes disturbing soils in the gravel pit, Piper's daisy would be eliminated in that area. However, because of the species' wide distribution, construction would not be expected to negatively affect the viability of this species on the Hanford Site (Bergsman et al., 1994).

DOE has completed consultations with the U.S. Fish and Wildlife Service regarding threatened and endangered species for the proposed construction sites of foreign research reactor spent nuclear fuel storage facilities at the Hanford Site, as required by the Endangered Species Act.

The modification of FMEF for dry storage would take place within the fenced 400 Area. This area has already been disturbed and no further ecological impacts would be expected.

#### **F.4.3.2.1.9 Noise**

Noise generated onsite by construction and operation of a new dry storage facility should not adversely affect the public or the Hanford Site environment. Based on a noise impact analysis for locating a new production reactor at the Hanford Site, ambient noise levels would not exceed the limits set by Washington State or the Environmental Protection Agency. The analysis indicated that any increased traffic along the major roadways from construction and operation of the new production reactor would result in little or no increase in the annoyance level experienced by communities or individuals. As a result, no significant noise impacts from activities associated with the new dry storage facility construction and operation are expected at receptor locations outside the Hanford Site boundary or at residences along the major highways leading to either candidate storage site.

#### F.4.3.2.1.10 Traffic and Transportation

Construction materials, wastes, and excavated materials would be transported both onsite and offsite. These activities would result in increases in operation of personal-use vehicles by commuting construction workers, commercial truck traffic, and in traffic associated with the daily operations of the Hanford Site. Again, traffic congestion would not be a significant problem.

Traffic congestion, although moderate at shift changes, would not be noticeably worse due to this level of construction effort.

#### F.4.3.2.1.11 Occupational and Public Health and Safety

*Emissions-Related Impacts:* Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Hanford Site would be attributed to emissions of radioactive material that could be carried by the wind offsite. The general public would be too far from the locations where handling activities or storage take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and resulting doses are discussed in Section F.6 of this appendix. Table F-57 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Hanford Site. Integrated doses for the duration of a specific period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-57 Annual Public Impacts for Receipt and Storage of Foreign Research  
Reactor Spent Nuclear Fuel at the Hanford Site (Dry Storage)**

Facility	MEI Dose (mrem/yr)	MEI Risk (LCF/yr)	Population Dose (person-rem/yr)	Population Risk (LCF/yr)
<i>Receipt/Unloading at:</i>				
• FMEF (dry storage)	0.00020	$1.0 \times 10^{-10}$	0.011	0.0000055
• New Dry Storage Facility	0.00025	$1.3 \times 10^{-10}$	0.015	0.0000075
<i>Storage at:</i>				
• FMEF (dry storage)	0	0	0	0
• New Dry Storage Facility	0	0	0	0

*Handling-Related Impacts:* Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask). Analysis option 3A involves the receipt and unloading of 161 shipments of foreign research reactor spent nuclear fuel from the Idaho National Engineering Laboratory and/or Savannah River Site and 193 shipments directly from ports into a dry storage facility. The assumptions and methodologies used to calculate the doses to a working crew associated with the handling activities of the foreign research reactor spent nuclear fuel are described in Section F.5 of this appendix.

Table F-58 presents the population dose and risk that would be received by the members of the working crew if that working crew handled the total number of transportation casks at the Hanford Site. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the

**Table F-58 Handling-Related Impacts to Workers at the Hanford Site  
(New Dry Storage)**

	<i>Worker Population Dose (Person-rem)</i>	<i>Worker Population Risk (LCF)</i>
	<i>FMEF/New Dry Storage</i>	<i>FMEF/New Dry Storage</i>
Phase 2	266/113 <sup>a</sup>	0.11/0.05 <sup>a</sup>

<sup>a</sup> The two numbers represent the cask/vault designs respectively.

administrative or regulatory limit at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this limit, he or she would be rotated into a different job to prevent further exposure. This regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent.

#### **F.4.3.2.1.12 Material, Utility, and Energy Requirements**

Construction of a new dry storage facility at the Hanford Site would consume 21,800 m<sup>3</sup> (28,500 yd<sup>3</sup>) of concrete and 5,200 metric tons (5,750 tons) of steel. The total energy and water requirements during construction are estimated to be 835,000 l (221,000 gal) for fuel, and 7.75 million l (2 million gal) for water. The annual utility and energy requirements during operations are shown in Table F-59. These requirements represent a small percent of current requirements for the Hanford Site. No new generation or treatment facilities would be necessary, and connections to existing networks would require only short tie-in lines. Increases in consumption would be minimal because overall activity on the Hanford Site is expected to decrease because of changes in site mission and a general reduction in employment.

**Table F-59 Annual Utility and Energy Requirements for New Dry Storage at the  
Hanford Site**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>Dry Storage Usage</i>	<i>Percent Increase</i>
Electricity (MW-hr/yr)	340,000	800 - 1,000	0.3 percent
Fuel (l/yr)	83,000,000	0	0 percent
Water (l/yr)	15,000,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.01 percent <sup>a</sup> 0.003 percent <sup>b</sup>

<sup>a</sup> During receipt and handling.

<sup>b</sup> During storage.

#### **F.4.3.2.1.13 Waste Management**

Construction of a new dry storage facility at the Hanford Site would generate 1,800 m<sup>3</sup> (2,340 yd<sup>3</sup>) of debris. The annual quantities of waste generated during operations are shown in Table F-60. These quantities, represent a very small percent increase above current levels at the Hanford Site. Existing waste management storage and disposal activities at Hanford Site could accommodate the waste generated by a new dry storage facility. Therefore, the impact of this waste on existing Hanford Site waste management capacities would be minimal.

**Table F-60 Annual Waste Generated for New Dry Storage at the Hanford Site**

<i>Waste Form</i>	<i>Baseline Site Generation</i>	<i>Dry Storage Generation</i>	<i>Percent Increase</i>
High-Level (m <sup>3</sup> /yr)	240	none	0 percent
Transuranic (m <sup>3</sup> /yr)	170	none	0 percent
Solid Low-Level (m <sup>3</sup> /yr)	20,000	22 <sup>a</sup> 1 <sup>b</sup>	0.11 percent <sup>a</sup> 0.005 percent <sup>b</sup>
Wastewater (l/yr)	210,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.75 percent <sup>a</sup> 0.2 percent <sup>b</sup>

<sup>a</sup> During receipt and handling.

<sup>b</sup> During storage.

#### **F.4.3.2.2 Wet Storage**

Analysis option 3B involves long-term wet storage of foreign research reactor spent nuclear fuel at the Hanford Site. This storage option would require the construction of a new wet storage facility.

##### **F.4.3.2.2.1 Land Use**

A new wet storage facility would be located on the 200 Area Plateau or in conjunction with the WNP-4 Spray Cooling Pond. These areas have already been developed for industrial use. Construction activities, including laydown areas, would disturb 2.8 ha (7 acres) of land at either area. A new wet storage facility would occupy 3,800 m<sup>2</sup> (41,000 ft<sup>2</sup>) of land and would move 18,000 m<sup>3</sup> (24,000 yd<sup>3</sup>) of soil. Neither construction nor operation of a new wet storage facility at either area would significantly impact land use patterns on the Hanford Site.

##### **F.4.3.2.2.2 Socioeconomics**

As discussed in Section F.3.2 the total capital cost of a new wet storage facility is estimated to be \$449 million. Construction activities are projected to take 4 years. Assuming that the capital cost is evenly distributed over this 4-year period, the annual expenditures would be about \$112.2 million. This represents approximately 8.7 percent of the estimated FY 1995 total expenditures for the Hanford Site (1,288 million). The relative socioeconomic impact from annual construction expenditures on the region of influence would be positive. The annual operations costs of a new wet storage facility are estimated to be \$23.3 million for receipt and handling and \$3.5 million for storage. These costs represent about 1.8 percent and 0.3 percent of FY 1995 total expenditures for the Hanford Site. The relative socioeconomic impact from annual operation expenditures on the region of influence would be small.

Direct employment associated with construction of a new wet storage facility is estimated to be 157 persons. The relative socioeconomic impact from direct construction employment on the region of influence would be small. In addition, when compared to the projected FY 1995 work force at Hanford Site of approximately 18,500 persons, the relative socioeconomic impact of this temporary increase in construction employment would be insignificant. Direct employment associated with operations of a new wet storage facility is estimated to be 30 persons. The relative socioeconomic impact of this increase in operations employment would be small to both the region of influence and the Hanford Site.

#### **F.4.3.2.2.3 Cultural Resources**

Impacts to cultural resources would be the same as for new dry storage (Section F.4.3.2.1.3).

The potential for impacting cultural resources would be even less for the WNP-4 Spray Pond because the structures are all essentially in place. Thus, there would be no opportunity for discovery of cultural resources during construction.

#### **F.4.3.2.2.4 Aesthetic and Scenic Resources**

Impacts to aesthetic and scenic resources would be the same as for new dry storage (Section F.4.3.2.1.4).

#### **F.4.3.2.2.5 Geology**

Impacts to geology would be the same as for new dry storage (Section F.4.3.2.1.5).

#### **F.4.3.2.2.6 Air Quality**

*Nonradiological Emissions:* Construction of a new wet storage facility would necessitate the clearing and grading of 2.8 ha (7 acres) of land. In comparison, 3.7 ha (9 acres) of land would be disturbed by new dry storage construction. Therefore, air quality impacts associated with wet storage construction would be bound by those associated with dry storage construction (Section F.4.3.2.1.6).

No nonradiological emissions from the operation of the new wet storage facility are expected.

*Radiological-Emissions:* Incident-free airborne releases from the new wet storage facility would be limited to radioactive noble gases and some radioactive iodine which could be released from the stored fuel prior to canning. The airborne materials released to the building atmosphere during incident-free operations would be filtered by the building heating and ventilation system. Radioactive and nonradioactive effluent gases would be routed through double-banked high-efficiency particulate air filters prior to release to the environment through an exhaust air system. The high-efficiency particulate air filter would have a minimum efficiency of 99.97 percent for 0.3 micron diameter particulates and would allow in-place dioctyl phthalate testing.

The new wet storage facility would discharge all ventilated gas, except truck exhaust, to the facility's exhaust system. Truck exhaust would be discharged directly to the environment during cask off-loading operation in the truck receiving area. The exhaust air system would employ a detector to monitor <sup>137</sup>Cs as an indicator nuclide. For other building areas which would be sources of airborne radioactive contamination, the heating, ventilation, and air conditioning system would be designed to maintain airflow from areas of low potential contamination into areas of higher potential contamination. These airborne effluents would be required to be below the radioactivity concentration guides listed in DOE 5480.1B (DOE, 1989b) for both onsite and offsite concentrations.

Air emissions from the new wet storage facility are expected to be similar to the air emissions from the IFSF at the Idaho National Engineering Laboratory. The annual air emission for the IFSF was designed to result in ground-level concentrations of less than 0.003 percent of DOE 5480.1B limits for uncontrolled areas.

Radiological emissions from the operation of the new wet storage facility were calculated based on the methodology and assumptions used in Appendix F, Section F.6. The annual emission releases from the wet storage facility during the receipt and unloading and storage are provided in Section F.6.6.1.

No radiological emissions would be produced during construction of a new wet storage facility.

#### **F.4.3.2.2.7 Water Resources**

The annual water usage during construction and operation of a new wet storage facility is estimated to be about 1.9 million l (502,000 gal) and 2.7 million l (0.72 million gal), respectively. With an annual average water usage of approximately 15,000 million l (3,960 million gal) for the Hanford Site, these amounts represent an increase of about 0.02 percent and less than 0.005 percent, respectively. Therefore, a new wet storage facility would have minimal impact on water resources at the Hanford Site.

Best-management practices during construction would prevent sediment runoff or spills of fuels or chemicals. Therefore, construction activities should have no impact on water quality at the Hanford Site. The impact on water quality during operations would also be negligible. Existing water treatment facilities at the Hanford Site could accommodate any new domestic and process wastewater streams from a new wet storage facility. The expected total flow volumes at the Hanford Site would still be well within the design capacities of treatment systems at the Hanford Site. A new wet storage facility would meet National Pollutant Discharge Elimination System limits and reporting requirements, so no impact on the water quality of receiving streams is expected.

#### **F.4.3.2.2.8 Ecology**

Impacts to ecology would be the same as for new dry storage (Section F.4.3.2.1.8).

#### **F.4.3.2.2.9 Noise**

Impacts from noise would be the same as for new dry storage (Section F.4.3.2.1.9).

#### **F.4.3.2.2.10 Traffic and Transportation**

Impacts from traffic and transportation would be the same as for new dry storage (Section F.4.3.2.1.10).

#### **F.4.3.2.2.11 Occupational and Public Health and Safety**

*Emissions-Related Impacts:* Doses that could be received by the public during incident-free operation associated with the receipt and management of the foreign research reactor spent nuclear fuel at the Hanford Site would be attributed to emissions of radioactive material that could be carried by wind offsite. The public would be too far from the locations where handling activities or storage take place to receive any dose from direct exposure. Doses were calculated for the MEI, defined as an individual at the site boundary receiving the maximum exposure, and for the general population within an 80 km (50 mi) radius of the storage facility. These doses would result from incident-free airborne radiological emissions assumed to be released from the unloading of the transportation cask and the storage facility during storage. The methodology and assumptions used for the calculation of the radiological emissions and

resulting doses are discussed in Section F.5 of this appendix. Table F-61 summarizes the annual emission-related doses to the public and the associated risks for the MEI and population at the Hanford Site. Integrated doses for the duration of a specific implementation period can be obtained by multiplying the annual dose by the number of years in the period.

**Table F-61 Annual Public Impacts for Receipt and Storage of Foreign Research Reactor Spent Nuclear Fuel at the Hanford Site (Implementation Alternative 5 of Management Alternative 1)**

<i>Facility</i>	<i>MEI Dose (mrem/yr)</i>	<i>MEI Risk (LCF/yr)</i>	<i>Population Dose (person-rem/yr)</i>	<i>Population Risk (LCF/yr)</i>
<i>Receipt/Unloading at:</i>				
• WNP-4 Spray Pond	0.00022	$1.1 \times 10^{-10}$	0.0058	0.0000029
• New Wet Storage Facility	0.00020	$1.0 \times 10^{-10}$	0.012	0.000006
<i>Storage at:</i>				
• WNP-4 Spray Pond	$5.9 \times 10^{-10}$	$3.0 \times 10^{-16}$	$1.6 \times 10^{-8}$	$8.0 \times 10^{-12}$
• New Wet Storage Facility	$8.8 \times 10^{-10}$	$4.4 \times 10^{-16}$	$6.9 \times 10^{-8}$	$3.5 \times 10^{-11}$

*Handling-Related Impacts:* Workers at the site would receive radiation doses during handling operations (i.e., receiving and unloading the transportation cask), transferring the foreign research reactor spent nuclear fuel from one facility to another, or preparing the foreign research reactor spent nuclear fuel for shipment offsite. Analysis option 3B involves the receipt of 161 shipments of foreign research reactor spent nuclear fuel from Idaho National Engineering Laboratory and/or Savannah River Site and 193 shipments directly from the ports into a wet storage facility. The assumptions and methodologies used to calculate the doses to a working crew associated with the handling activities of the foreign research reactor spent nuclear fuel are described in Section F.5 of this appendix.

Table F-62 presents the population dose that would be received by the members of the working crew and the associated risks if that working crew handled the total number of transportation casks at the Hanford Site. The worker MEI doses and risks were not calculated because of the large uncertainties associated with the assumptions for such calculations. However, the upper bound for such a dose would be equal to the administrative or regulatory limit at the site. For DOE radiation workers, the regulatory limit is 5,000 mrem per year. All these workers would be monitored and if any worker's dose approached this limit, he or she would be rotated into a different job to prevent further exposure. This regulatory limit provides a very conservative upper bound on the radiation dose for the worker MEI. If a single worker received the full 5,000 mrem per year dose for the full 13 years of potential foreign research reactor spent nuclear fuel receipt, then the MEI dose would be 65,000 mrem. For this dose, the associated risk of incurring an LCF would be 2.6 percent.

#### **F.4.3.2.2.12 Material, Utility, and Energy Requirements**

Construction of a new wet storage facility at the Hanford Site would consume 12,400 m<sup>3</sup> (16,260 yd<sup>3</sup>) of concrete and 3,100 metric tons (3,443 tons) of steel. The total energy and water requirements during construction are estimated to be 600,000 l (159,000 gal) for fuel, and 4.4 million l (1.2 million gal) for water. The annual utility and energy requirements during operations are shown in Table F-63. These requirements represent a small percent of current requirements for the Hanford Site. No new generation or treatment facilities would be necessary, and connections to existing networks would require only short tie-in lines. Increases in consumption would be minimal because overall activity on the Hanford Site is expected to decrease because of changes in site mission and a general reduction in employment.

**Table F-62 Handling-Related Impacts to Workers at the Hanford Site  
(Implementation Alternative 5 of Management Alternative 1)**

	<i>Worker Population Dose (person-rem)</i>	<i>Worker Population Risk (LCF)</i>
	<i>New Wet Storage Facility or WNP-4 Spray Pond</i>	<i>New Wet Storage Facility or WNP-4 Spray Pond</i>
Phase 2	109	0.04

**Table F-63 Annual Utility and Energy Requirements for New Wet Storage at the Hanford Site**

<i>Commodity</i>	<i>Baseline Site Usage</i>	<i>Wet Storage Usage</i>	<i>Percent Increase</i>
Electricity (MW-hr/yr)	340,000	1,000-1,500	0.44 percent
Fuel (l/yr)	83,000,000	0	0 percent
Water (l/yr)	15,000,000,000	2,700,000 <sup>a</sup> 1,500,000 <sup>b</sup>	0.02 percent 0.01 percent

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

#### F.4.3.2.2.13 Waste Management

Construction of a new wet storage facility at the Hanford Site would generate 2,600 m<sup>3</sup> (10,300 yd<sup>3</sup>) of debris. The annual quantities of waste generated during operations are shown in Table F-64. These quantities, represent a very small percentage increase above current levels at the Hanford Site. Existing waste management storage and disposal activities at Hanford Site could accommodate the waste generated by a new wet storage facility. Therefore, the impact of this waste on existing Hanford Site waste management capacities would be minimal.

**Table F-64 Annual Waste Generated for New Wet Storage at the Hanford Site**

<i>Waste Form</i>	<i>Baseline Site Generation</i>	<i>Wet Storage Generation</i>	<i>Percent Increase</i>
High-Level Waste (m <sup>3</sup> /yr)	240	none	0 percent
Transuranic Waste (m <sup>3</sup> /yr)	170	none	0 percent
Solid Low-Level Waste (m <sup>3</sup> /yr)	20,000	16 <sup>a</sup> 1 <sup>b</sup>	0.08 percent 0.005 percent
Wastewater (l/yr)	210,000,000	1,590,000 <sup>a</sup> 400,000 <sup>b</sup>	0.75 percent 0.2 percent

<sup>a</sup> During receipt and handling

<sup>b</sup> During storage

#### F.4.3.3 Accident Analysis

An evaluation of incident-free operations and hypothetical accidents at the Hanford Site is presented here based on the methodology in Appendix F, Section F.6. The evaluation assessed the possible radiation exposure to individuals and general population due to the release of radioactive materials. The analyses are based on the same operations carried out at the different potential storage locations and the same accidents at any of the sites evaluated. Information concerning radiation doses to individuals and the general population are the same as set forth in Section F.4.1.3.

Table F-65 presents frequency and consequences in terms of mrem or person-rem, of postulated accidents to the offsite MEI, NPAI, and offsite population for the 95th-percentile meteorological conditions using the assumptions and input values discussed above. The worker doses are calculated only for the 50th-percentile meteorology. This is an individual assumed to be 100 m (330 ft) downwind of the accident. DOE did not estimate the worker population dose.

**Table F-65 Frequency and Consequences of Accidents at the Hanford Site**

	Frequency (per year)	Consequences			
		MEI (mrem)	NPAI (mrem)	Population (person-rem)	Worker (mrem)
Dry Storage Accidents <sup>a</sup>					
• Spent Fuel Assembly Breach	0.16	3.0	0.57	42	50
• Dropped Fuel Cask	0.0001	0.26	0.0085	3.0	0.22
• Aircraft Crash wFire <sup>b</sup>	NA	NA	NA	NA	NA
Dry Storage Accidents at FMEF					
• Spent Fuel Assembly Breach	0.16	4.7	2.1	46	0.99
• Dropped Fuel Cask	0.0001	0.2	0.032	3.2	0.0049
• Aircraft Crash wFire <sup>b</sup>	NA	NA	NA	NA	NA

NA = Not Applicable

<sup>a</sup> New Dry Storage Facility

<sup>b</sup> Aircraft Crash accidents are not applicable to Hanford Site because their frequency of occurrence is less than one every ten million years.

Multiplying the frequency of each accident times its consequences and converting the radiation doses to LCF yields the annual risks associated with each potential accident at the Hanford Site. These annual risks are multiplied by the maximum duration of the implementation alternative at the Hanford Site to obtain conservative estimates of risks for the Hanford Site. These risk estimates are presented in Table F-66.

**Table F-66 Annual Risks of Accidents at the Hanford Site**

	Risks			
	MEI (LCF/yr)	NPAI (LCF/yr)	Population (LCF/yr)	Worker (LCF/yr)
<b>Dry Storage Accidents<sup>a</sup></b>				
• Spent Nuclear Fuel Assembly Breach	$2.4 \times 10^{-7}$	$4.6 \times 10^{-8}$	0.0034	0.0000032
• Dropped Fuel Cask	$1.3 \times 10^{-11}$	$4.3 \times 10^{-13}$	$1.5 \times 10^{-7}$	$8.8 \times 10^{-12}$
• Aircraft Crash w\Fire <sup>b</sup>	NA	NA	NA	NA
<b>Dry Storage Accidents at FMEF</b>				
• Spent Nuclear Fuel Assembly Breach	$3.7 \times 10^{-7}$	$1.7 \times 10^{-7}$	0.0037	$6.4 \times 10^{-8}$
• Dropped Fuel Cask	$8 \times 10^{-12}$	$1.6 \times 10^{-12}$	$1.6 \times 10^{-7}$	$2.5 \times 10^{-13}$
• Aircraft Crash with Fire <sup>b</sup>	$10^{-12}$	NA	NA	NA

NA = Not Applicable

<sup>a</sup> New Dry Storage Facility

<sup>b</sup> Aircraft crash accidents are not applicable to Hanford Site because their frequency of occurrence is less than one every ten million years

Table F-67 presents the frequency and consequences of the accidents analyzed for the Hanford Site for new wet storage (Implementation Alternative 5 of Management Alternative 1). Multiplying the frequency of each accident times its consequences and converting the radiation doses to LCF yields the annual risks associated with each potential accident at the Hanford Site. These annual risks are multiplied by the

**Table F-67 Frequency and Consequences of Accidents at the Hanford Site  
(Implementation Alternative 5 of Management Alternative 1)**

	Frequency (per year)	Consequences			
		MEI (mrem)	NPAI (mrem)	Population (person-rem)	Worker (mrem)
New Wet Storage Facility:					
• Spent Nuclear Fuel Assembly Breach	0.16	0.13	0.0033	1.6	0.25
• Accidental Criticality	0.0031	64	14	740	3,600
• Aircraft Crash <sup>a</sup>	NA	NA	NA	NA	NA
WNP-4 Spray Pond:					
• Spent Nuclear Fuel Assembly Breach	0.16	0.15	0.0033	1.3	0.00024
• Accidental Criticality	0.0031	97	76	620	120
• Aircraft Crash <sup>a</sup>	NA	NA	NA	NA	NA

NA = Not Applicable

<sup>a</sup> Aircraft crash accidents are not applicable to the Hanford Site because their frequency of occurrence is less than one every ten million years.

maximum duration of this implementation alternative at the Hanford Site to obtain conservative estimates of risks at the Hanford Site. Table F-68 presents the risk estimates for this implementation alternative.

**Table F-68 Annual Risks of Accidents at the Hanford Site (Implementation  
Alternative 5 of Management Alternative 1)**

	Risks			
	MEI (LCF/yr)	NPAI (LCF/yr)	Population (LCF/yr)	Worker (LCF/yr)
<b>New Wet Storage Facility:</b>				
• Fuel Assembly Breach	$1.1 \times 10^{-8}$	$2.7 \times 10^{-10}$	0.00013	$1.6 \times 10^{-8}$
• Accidental Criticality	$1.0 \times 10^{-7}$	$2.2 \times 10^{-8}$	0.0012	0.0000044
• Aircraft Crash <sup>a</sup>	NA	NA	NA	NA
<b>WNP-4 Spray Pond:</b>				
• Fuel Assembly Breach	$1.2 \times 10^{-8}$	$2.7 \times 10^{-10}$	0.00011	$1.5 \times 10^{-11}$
• Accidental Criticality	$1.5 \times 10^{-7}$	$1.2 \times 10^{-7}$	0.00096	$1.5 \times 10^{-7}$
• Aircraft Crash <sup>a</sup>	NA	NA	NA	NA

NA = Not Applicable

<sup>a</sup> Aircraft crash accidents are not applicable to the Hanford Site because their frequency of occurrence is less than one every ten million years.

#### F.4.3.3.1 Secondary Impact of Radiological Accidents at the Hanford Site

In the event of an accidental release of radioactivity, there is a potential for impacts to land uses, cultural resources, water quality, ecology, national defense, and local economies (secondary impacts). For this analysis, secondary impacts of radiological accidents involving foreign research reactor spent nuclear fuel have been qualitatively assessed based on the calculations presented in Section F.4.3.3. Radiological accidents that resulted in doses to the MEI of less than the annual Federal radiological exposure limit for the public of 100 mrem (10 CFR Part 20) were considered to have no secondary impacts.

The MEI dose provides a measure of the air concentration and radionuclide deposition at the receptor location. As such, it can be used to express the level of contamination from a given radiological accident.

In estimating the human health effects from radiological exposure (as presented in Section F.4.1.3), the MEI dose evaluates four pathways: (1) air immersion, (2) ground surface, (3) inhalation, and (4) ingestion. In estimating the environmental effects from radiological exposure, however, only the air immersion and ground surface pathways need be considered.

At the Hanford Site, the radiological accident with the highest MEI dose is the fuel assembly breach at a dry storage facility located at the FMEF (Table F-65). For this accident, the MEI dose would be 3.9 mrem, which is less than the 100 mrem limit used in this analysis. Therefore, no secondary impacts to land uses, cultural resources, water quality, ecology, national defense, and local economies from radiological accidents involving foreign research reactor spent nuclear fuel storage are expected at the Hanford Site.

#### **F.4.3.4 Cumulative Impacts at the Hanford Site**

This section presents the cumulative impacts of the proposed action, potential impacts of other major contemplated DOE actions, and current activities at the Hanford Site. A major portion of the presentation is based on information included in the Programmatic SNF&INEL Final EIS (DOE, 1995g), the Management of Spent Nuclear Fuel from the K Basins Draft EIS (DOE, 1995d) and the Safe Interim Storage of Hanford Tank Wastes Final EIS (DOE, 1995c).

Table F-69 summarizes the cumulative impacts for land use, socioeconomics, air quality, occupational and public health and safety, energy and water consumption and waste generation. The table also presents the contributions from the storage of foreign research reactor spent nuclear fuel on the cumulative impacts at the Hanford Site. For the purposes of this analysis, both the contributions from management of foreign research reactor spent nuclear fuel and the cumulative impacts were maximized by selecting the Centralization Alternative of the Programmatic SNF&INEL Final EIS at the Hanford Site.

As shown in Table F-69, the contribution from management of foreign research reactor spent nuclear fuel to the cumulative impacts at the Hanford Site would be minimal. It is concluded, therefore, that the implementation of any of the alternatives (including the Centralization Alternative) for the DOE spent nuclear fuel management program would not be expected to significantly contribute to cumulative impacts.

#### **F.4.3.5 Unavoidable Adverse Environmental Impacts**

Unavoidable impacts associated with foreign research reactor spent nuclear fuel management activities would derive principally from construction activities needed for new storage facilities. There would be displacement of some animals from the construction site and the destruction of plant life within the area scoped for construction [up to 4 ha (10 acres)]. Criteria pollutants and radionuclides, would also be released in up to permitted quantities. Traffic congestion and noise would be expected to increase by a few percent during the construction of major facilities.

#### **F.4.3.6 Irreversible and Irretrievable Commitments of Resources**

The irreversible and irretrievable commitment of resources resulting from the construction and operation of facilities for the receipt and storage of foreign research reactor spent nuclear fuel would involve materials that could not be recovered or recycled or that would be consumed or reduced to unrecoverable forms. The construction and operation of facilities for foreign research reactor spent nuclear fuel facilities at the Hanford Site would consume irretrievable amounts of electrical energy, fuel, concrete, sand, and gravel. Other resources used in construction would probably not be recoverable. These would include

**Table F-69 Cumulative Impacts at the Hanford Site**

<i>Environmental Impact Parameter</i>	<i>FRR SNF Contribution</i>	<i>Other Activities<sup>a</sup></i>	<i>Cumulative Impact</i>
Land Use (acres)	9	84,343 <sup>b</sup>	84,352
Socioeconomics (persons)	190 <sup>c</sup> /30 <sup>d</sup>	3300/1220 <sup>e</sup>	3,490 <sup>c</sup> /1250 <sup>d</sup>
Air Quality (nonradiological)	See Table F-56	NA	(f)
<i>Occupational and Public Health and Safety</i>			
• MEI Dose (rem/yr)	2.5x10 <sup>-7</sup>	0.0000036	0.0000036
LCF (per year)	1.3x10 <sup>-10</sup>	1.5x10 <sup>-9</sup>	1.5x10 <sup>-9</sup>
• Population dose (person-rem/yr)	0.015	0.22	0.235
LCF (per year)	0.0000075	0.00011	0.00011
• Worker Collective dose (person-rem/yr)	8.9 <sup>g</sup>	116.5	125.4
LCF (per year)	0.0035	0.0466	0.05
<i>Energy and Water Consumption</i>			
• Electricity (MW-hr/yr)	1,000	495,600	496,600
• Fuel (million l/yr)	0	94.4	94.4
• Water (million l/yr)	2.2	15,004	15,006
<i>Waste Generation</i>			
• High-Level (m <sup>3</sup> /yr)	0	354	354
• Low-Level (m <sup>3</sup> /yr)	22	33,310	33,332
• Transuranic (m <sup>3</sup> /yr)	0	240	240
• Mixed/hazardous (m <sup>3</sup> /yr)	0	402	402

<sup>a</sup> Other activities include: DOE-owned spent nuclear fuel management, construction and operation of a Laser Interferometer Gravitational-Wave Observatory, decommissioning of unused facilities, site restoration activities interim storage and tank wastes, management of spent nuclear fuel from the K basins, and current activities.

<sup>b</sup> Current operational areas constitute 83,767 acres

<sup>c</sup> Increase over baseline, during construction activities

<sup>d</sup> Increase over baseline, during operation activities

<sup>e</sup> Current working force is approximately 18,500 persons

<sup>f</sup> Nonradiological ground level cumulative concentrations would be within regulatory standards. 24-hour concentration for fugitive dust may exceed limits during construction of more than one facility simultaneously.

<sup>g</sup> The dose is due to the handling of the Foreign Research Reactor Spent Nuclear Fuel during receipt averaged over 30 years

finished steel, aluminum, copper, plastics, and lumber. Most of this material would be incorporated in foundations, structures, and machinery.

#### F.4.3.7 Mitigation Measures

Mitigation is addressed in general terms and describes typical measures that Hanford Site could implement. The analyses indicate that the environmental consequences attributable to foreign research reactor spent nuclear fuel management activities at the Hanford Site would be minimal in most environmental media.

**Pollution Prevention:** DOE is responding to Executive Order 12856 and associated DOE orders and guidelines by reducing the use of toxic chemicals; improving emergency planning, response, and accident notification; and encouraging the development and use of clean technologies and the testing of innovative

pollution prevention technologies. Program components include waste minimization, source reduction and recycling, and procurement practices that preferentially procure products made from recycled materials. The pollution prevention program at the Hanford Site is being formalized in a Hanford Site Waste Minimization and Pollution Prevention Awareness Program Plan (DOE, 1995g).

The foreign research reactor spent nuclear fuel program activities would be conducted in accordance with this plan, and implementation of the pollution prevention and waste minimization plans would minimize impacts of wastes generated during spent nuclear fuel management activities (DOE, 1995g).

*Socioeconomics:* The level of predicted employment for foreign research reactor spent nuclear fuel activities at the Hanford Site is not large enough in comparison with present Hanford, local, or regional employment to produce a boom-bust impact on the economy (DOE, 1995g).

*Cultural Resources:* To avoid loss of cultural resources during construction of foreign research reactor spent nuclear fuel facilities on the Hanford Site, a cultural resources survey of the area of interest would be conducted by Pacific Northwest Laboratories Cultural Resources staff. Assuming no such resources were found, construction would proceed. If, however, during construction (earth moving) any cultural resource is discovered, construction activities would be halted and the Pacific Northwest Laboratories Cultural Resources staff called upon to evaluate and determine the appropriate disposition of the find.

To avoid loss of cultural resources during operation, such as unauthorized artifact collection, workers could be educated through programs and briefing sessions to inform them on applicable laws and regulations for site protection. These educational programs would stress the importance of preserving cultural resources and specifics of the laws and regulations for site protection. The exact locations of cultural resources are not identified by the Pacific Northwest Laboratories Cultural Resources group, therefore, any such artifact collection would be in an area discovered by the worker(s) (DOE, 1995g).

*Geology:* Soil loss would be controlled during construction using standard dust suppression techniques on disturbed soil and by stockpiling with cover where necessary. Following construction, soil loss would be controlled by revegetation and relandscaping of disturbed areas (DOE, 1995g).

*Air Resources:* To avoid impacts associated with emissions of fugitive dust during construction activities, exposed soils would be treated using standard dust suppression techniques. New facility sources of pollutant emissions to the atmosphere would be designed using best available technology to reduce emissions to "as low as reasonably achievable" levels (DOE, 1995g).

*Water Resources:* The impacts to surface and groundwater sources could be minimized through recycling of water, where feasible, and with cleanup of excess process water before release to ground or surface water (DOE, 1995g).

*Noise:* Generation of construction and operations noise would be reduced, as practicable, by using equipment that complies with noise guidelines (40 CFR Parts 201-211). Construction workers and other personnel working in environments exceeding U.S. Environmental Protection Agency-recommended guidelines during spent nuclear fuel storage, construction, or operation would be provided with earmuffs or earplugs approved by the Occupational Safety and Health Administration (29 CFR Part 1910). Because of the remote location of the Hanford Site foreign research reactor spent nuclear fuel activities, there would be no noise impacts with respect to the public for which mitigation would be necessary (DOE, 1995g).

*Traffic and Transportation:* At sites with increasing traffic concerns, DOE would encourage use of high-occupancy vehicles (such as vans or buses), implementing carpooling and ride-sharing programs, and staggering work hours to reduce peak traffic.

*Occupational and Public Health and Safety:* Although no radiological impacts on workers or the public were evident from the evaluation of incident-free foreign research reactor spent nuclear fuel activities at Hanford, further improvement in controls to protect both workers and the general public is a continuing activity. The "as low as reasonably achievable" principle would be used for controlling radiation exposure and exposure to hazardous/toxic substances. The Hanford Site would continue to refine its current emergency planning, emergency preparedness, and emergency response programs in place to protect both workers and the public (DOE, 1995g).

*Site Utilities and Support Services:* No mitigation measures beyond those identified for ground disturbance activities associated with bringing power and water to the foreign research reactor spent nuclear fuel site would appear necessary. In those cases, use of standard dust suppression techniques and revegetation of disturbed areas would mitigate ground disturbance impacts.

*Accidents:* The Hanford Site maintains an emergency response center and has emergency action plans and equipment to respond to accidents and other emergencies. These plans include training of workers, local emergency response agencies (such as fire departments) and the public communication systems and protocols, readiness drills, and mutual aid agreements. The plans would be updated to include consideration of new foreign research reactor spent nuclear fuel facilities and activities. Design of new facilities to current seismic and other facility protection standards would reduce the potential for accidents, and implementation of emergency response plans would substantially mitigate the potential for impacts in the event of an accident.

#### **F.4.4 Oak Ridge Reservation**

If the Oak Ridge Reservation site is the site to manage DOE-owned spent nuclear fuel under the Programmatic SNF&INEL Final EIS, foreign research reactor spent nuclear fuel would be received and managed first at the Savannah River Site and/or the Idaho National Engineering Laboratory for the period required for the Oak Ridge Reservation to construct and to place in operation new facilities to accommodate the spent nuclear fuel. As discussed in previous sections, this period (Phase 1) is estimated to be about 10 years. At the end of Phase 1 (e.g., start of Phase 2), the Oak Ridge Reservation would be able to receive and manage foreign research reactor spent nuclear fuel that would be shipped from the Savannah River Site and/or the Idaho National Engineering Laboratory and directly from the ports for those shipments made after Phase 1 concludes. Management of the foreign research reactor spent nuclear fuel would continue at the Oak Ridge Reservation until ultimate disposition.

The amount of spent nuclear fuel that would be received and managed at the Oak Ridge Reservation under Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS. Accordingly, in Phase 2, the Oak Ridge Reservation could receive the aluminum-based foreign research reactor spent nuclear fuel managed at the Savannah River site during Phase 1, Eastern foreign research reactor spent nuclear fuel under the Regionalization by Geography Alternative, or all foreign research reactor spent nuclear fuel under the Centralization Alternative.

As a Phase 2 site, the Oak Ridge Reservation would receive and manage foreign research reactor spent nuclear fuel at a new dry storage facility to be constructed on the West Bear Creek Valley Site. The location is preferred among the four locations considered in a siting study performed for spent nuclear fuel management (MMES, 1994). Description of the new dry storage facility is provided in Section 2.6.5.1.1.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Oak Ridge Reservation is based on the above considerations. The analysis options selected do not represent all possible combinations but a reasonable set that provides a typical, and in some cases, bounding estimate of the resulting impacts.

The specific analysis options are as follows:

- 4A. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Oak Ridge Reservation where it would be managed at a new dry storage facility until ultimate disposition. Spent nuclear fuel arriving in the United States after Phase 1 concludes would also be received and managed at the new facility until ultimate disposition. For the purposes of this analysis, the total amount of spent nuclear fuel that would be managed in the new dry storage facility would be all the foreign research reactor spent nuclear fuel eligible under the policy (approximately 22,700 elements).

The implementation alternatives of Management Alternative 1 for managing foreign research reactor spent nuclear fuel in the United States discussed in Section 2.2.2 introduce additional analysis options that could be considered for the Oak Ridge Reservation as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Oak Ridge Reservation would receive the foreign research reactor spent nuclear fuel from the Idaho National Engineering Laboratory or the Savannah River Site and manage it in facilities sized for this amount of spent fuel. The impacts from the management of this amount of spent nuclear fuel would be bounded by analysis option 4A above.
- Under Implementation Subalternative 1b (Section 2.2.2.1), the Oak Ridge Reservation would receive only HEU from the Idaho National Engineering Laboratory and/or the Savannah River Site. The amount of spent nuclear fuel would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel at the Oak Ridge Reservation would be bounded by analysis option 4A above.
- Under Implementation Subalternative 1c (Section 2.2.2.1), the Oak Ridge Reservation would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which represents in uranium content approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis option 4A by a small percentage.
- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years and, therefore, the amount of spent nuclear fuel available for acceptance would also be decreased. In this case, the Oak Ridge Reservation would receive all foreign research reactor spent nuclear fuel from the Savannah River Site and/or the Idaho National Engineering Laboratory. The impacts from the management of the decreased amount of spent nuclear fuel at the Oak Ridge Reservation would be bounded by analysis option 4A above.
- Under Implementation Subalternative 2b, (Section 2.2.2.2), the acceptance of a small portion of the spent nuclear fuel would be extended over an indefinite period of time, but

the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in option 4A above.

- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be accepted by the United States as the foreign research reactor operators would consider their own alternatives on whether to send the spent nuclear fuel to the United States. The amount of fuel, in this case, cannot be quantified, however, the upper limit, as considered under analysis option 4A, would be bounding.
- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of the foreign research reactor spent nuclear fuel would be taken. The choices do not affect the management impacts at the Oak Ridge Reservation.
- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Oak Ridge Reservation for Phase 2 until ultimate disposition. For this implementation alternative an analysis option 4B, which is similar to 4A, is considered as follows:

4B. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Oak Ridge Reservation where it would be managed at a new wet storage facility. Spent nuclear fuel arriving in the United States after Phase 1 concludes would also be received and managed at the new facility until ultimate disposition. For the purposes of analysis, the total amount of spent nuclear fuel to be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel eligible under the policy (approximately 22,700 elements).

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. Based on the discussion in Section 2.3.6, the Oak Ridge Reservation would not be considered as a site for chemical separation.

Under Management Alternative 3 (Hybrid Alternative) the Oak Ridge Reservation is not considered.

#### **F.4.4.1 Existing Facilities**

There are no existing facilities for storing foreign research reactor spent nuclear fuel at Oak Ridge Reservation. Consequently, all potential environmental consequences from foreign research reactor spent nuclear fuel storage are related to new facility construction and operation.

#### **F.4.4.2 New Facilities (Phase 2)**

Analysis options 4A and 4B involve the use of new facilities as discussed above. The environmental impacts analyzed relate to the construction and operation of these facilities. The impacts include: land use; socioeconomics; cultural resources; aesthetic and scenic resources; geology; air and water quality; ecology; noise; traffic and transportation; occupational and public health and safety; materials, utilities, and energy; and waste management.